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POPULAR Woodworking MAGAZINE

FEBRUARY 2011 ■ #188

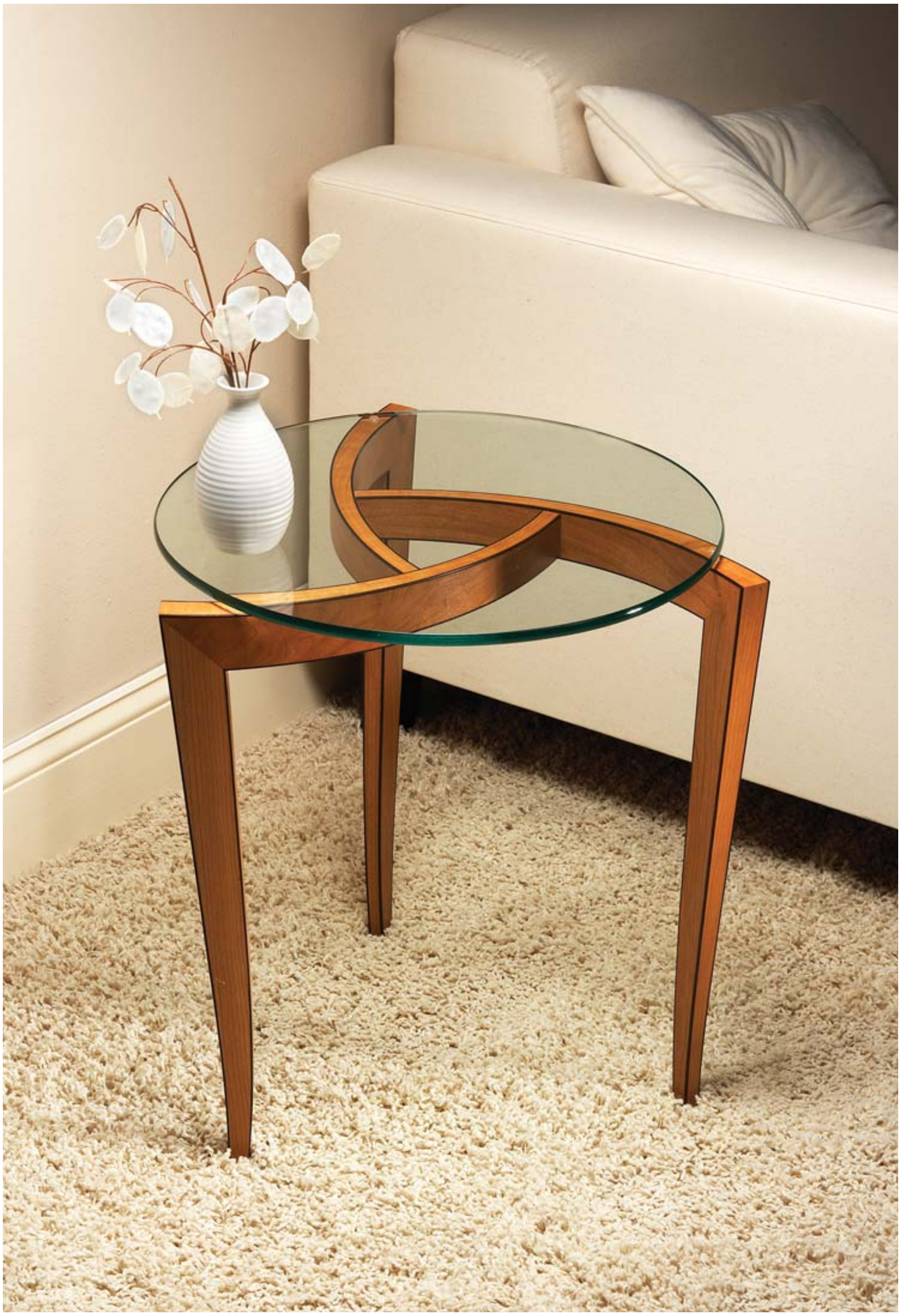
Tripod Table Has Curves, Inlay & Style

Michael Fortune Builds it Using Only Basic Tools

Roy Underhill's Folding (& Tragic) Walnut Bookstand

Planer Upgrade: Carbide Cutters Banish Tear-out

How to Choose, Fix Up & Use Moulding Planes



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- Cutting capacity/throat: 13½"
- Max. cutting height: 6"
- Blade size: 92½" - 93½" L (⅛" - ¾" W)
- Blade speed: 3000 FPM
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- Max. cutting height: 6"
- Blade size: 92½" - 93½" L (⅛" - ¾" W)
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- Cutting capacity/throat: 18¼"
- Max. cutting height: 12"
- Blade size: 143" L (⅛" - 1¼" W)
- Blade speeds: 1700 & 3500 FPM
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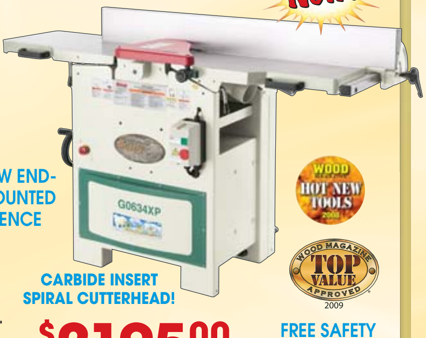
- Motor: 5 HP, 220V, single-phase
- Jointer table size: 14" x 59½"
- Cutterhead dia.: 3⅛"
- Cutterhead speed: 5034 RPM
- Max. jointer depth of cut: ⅛"
- Max. width of cut: 12"
- Planer feed rate: 22 FPM
- Max. planer depth of cut: ⅛"
- Max. planer cutting height: 8"
- Planer table size: 12¼" x 23⅛"
- Approx. shipping weight: 734 lbs.



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- Intake port: 6" with included 5" optional port
- Impeller: 13½"
- Height: 68½"
- Built-in remote control switch
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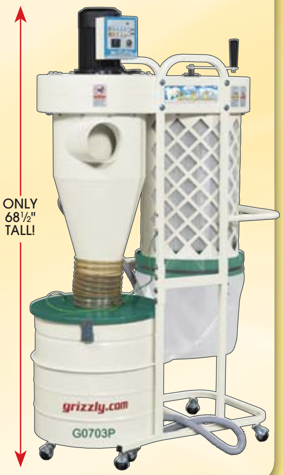

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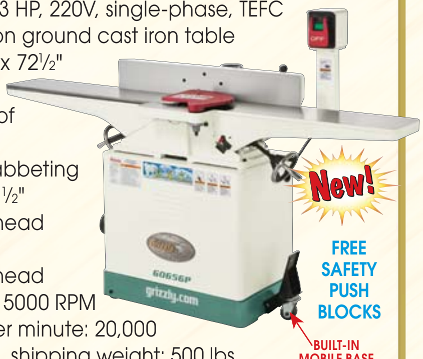
8" JOINTERS

- Motor: 3 HP, 220V, single-phase, TEFC
- Precision ground cast iron table size: 9" x 72½"
- Max. depth of cut: ⅛"
- Max. rabbeting depth: ½"
- Cutterhead dia.: 3"
- Cutterhead speed: 5000 RPM
- Cuts per minute: 20,000
- Approx. shipping weight: 500 lbs.



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- Motor: 3 HP, 220V, single-phase, TEFC
- Precision ground cast iron table size: 13" x 60"
- Fence: 5⅜" x 31¼"
- Cutterhead dia.: 3¾"
- Cutterhead speed: 4,950 RPM
- Bevel jointing: 45°, 90°, 135°
- Max. depth of cut: ⅛"
- Approx. shipping weight: 832 lbs.

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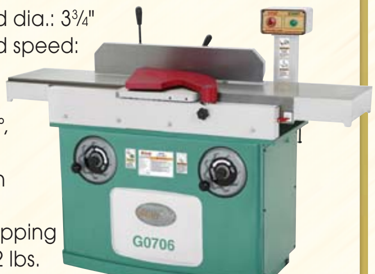

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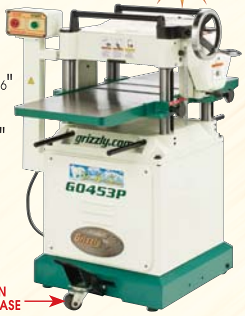
- Precision ground cast iron table size: 15" x 20"
- Min. stock thickness: ³⁄₁₆"
- Min. stock length: 8"
- Max. cutting depth: ⅛"
- Feed rate: 16 FPM & 30 FPM
- Cutterhead speed: 5000 RPM
- Approx. shipping weight: 660 lbs.



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WITH SPIRAL CUTTERHEAD

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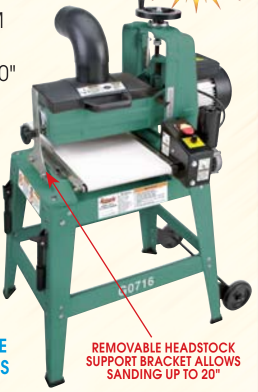
New!

- Motor: 1½ HP, 110V, single-phase
- Conveyor motor: ¹⁄₁₀ HP
- Drum speed: 2300 FPM
- Drum size: 5⅛" x 10"
- Max. sanding width: 10"
- Max. workpiece height: 2¹⁵⁄₁₆"
- Min. workpiece height: ³⁄₁₆"
- Variable feed speeds: 1-10 FPM
- 4" dust port
- Approx. shipping weight: 220 lbs.



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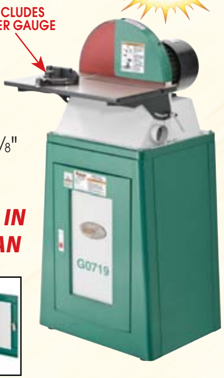
- Cast iron sanding disc size: 15"
- Cast iron table size: 12" x 20"
- Table tilt: 0 - 45°
- Floor to table height: 37⅝"
- Dust port: 2½"
- Approx. shipping weight: 232 lbs.

INCLUDES MITER GAUGE



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- Air suction cpacity: 450 CFM
- Max. static pressure: 7.2"
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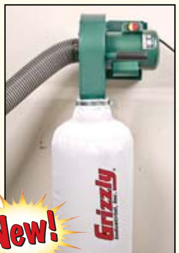

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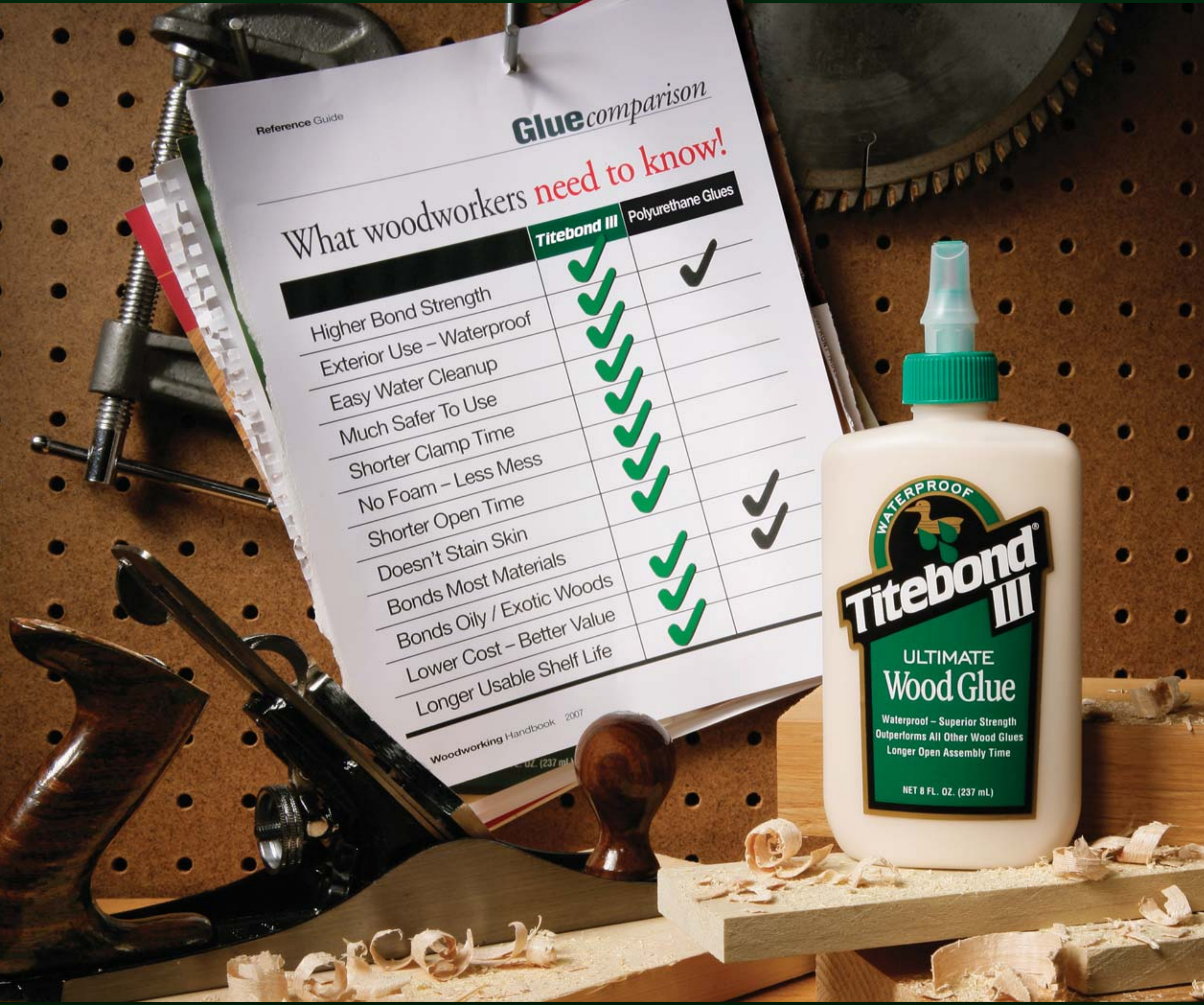

Reference Guide

Glue *comparison*

What woodworkers need to know!

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Higher Bond Strength	✓	
Exterior Use – Waterproof	✓	✓
Easy Water Cleanup	✓	
Much Safer To Use	✓	
Shorter Clamp Time	✓	
No Foam – Less Mess	✓	
Shorter Open Time	✓	
Doesn't Stain Skin	✓	
Bonds Most Materials		✓
Bonds Oily / Exotic Woods	✓	✓
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Longer Usable Shelf Life	✓	

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For more information, go to PWFREEINFO.COM.

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This eye-catching modern table can be made using steam-bending or clever bent laminations.

BY MICHAEL FORTUNE

ONLINE ▸ Gallery

See a gallery of more of the author's contemporary masterpieces.

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The author translates (and channels) the 18th-century French Master and builds a folding bookstand from one plank of wood.

BY ROY UNDERHILL

ONLINE ▸ 'The Woodwright's Shop' on the Web

Watch select episodes of Roy's PBS television show (now in its 30th season!) online.

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BY MARC ADAMS

ONLINE ▸ Visit a Veneer Plant

Discover how a log becomes a stack of veneer with our trip through the Atlantic Veneer slicing operation and Veneer Tech splicing plant.

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BY GLEN D. HUEY

ONLINE ▸ Installing a Carbide Cutterhead

Watch our video on installing a Byrd cutterhead in our planer.

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48 Shaker Wall Cupboard

This classic form from the New Lebanon Shaker community is easy to build in just a few hours.

BY CHRISTOPHER SCHWARZ

ONLINE ▸ Nail Clenching

Watch our free online video to discover how to properly clench a nail.

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BOOKSTAND, CUTTERHEAD & VENEER PHOTOS BY AL PARRISH; SHAKER CUPBOARD PHOTO BY KELLY MEHLER;
COVER PHOTO BY AL PARRISH

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POPULAR Woodworking MAGAZINE

Number 188, February 2011. *Popular Woodworking Magazine* (ISSN 0884-8823, USPS 752-250) is published 7 times a year, February, April, June, August, October, November and December, which may include an occasional special, combined or expanded issue that may count as two issues, by F+W Media, Inc. Editorial and advertising offices are located at 4700 E. Galbraith Road, Cincinnati, Ohio 45236. Unsolicited manuscripts, photographs and artwork should include ample postage on a self-addressed, stamped envelope (SASE); otherwise they will not be returned. Subscription rates: A year's subscription (7 issues) is $24.95; outside of the U.S. add $7/year ▪ Canada Publications Mail Agreement No. 40025316. Canadian return address: 2835 Kew Drive, Windsor, ON N8T 3B7 ▪ Copyright 2011 by *Popular Woodworking Magazine*. Periodicals postage paid at Cincinnati, Ohio, and additional mailing offices. Postmaster: Send all address changes to *Popular Woodworking Magazine*, P.O. Box 420235, Palm Coast, FL 32142-0235 Canada GST Reg. # R122594716 ▪ Produced and printed in the U.S.A.

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GREAT WOODSHOPS PHOTO BY CHRISTOPHER SCHWARZ

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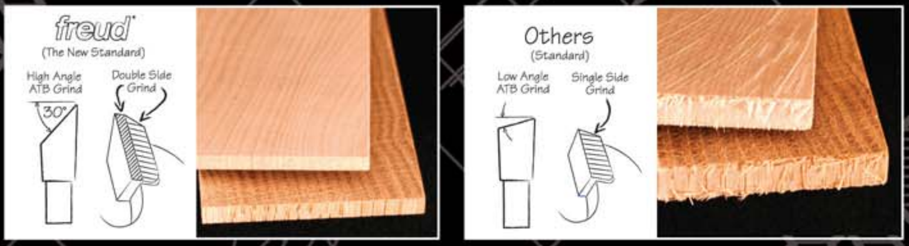
Freud's Fusion Tooth Design vs. Others



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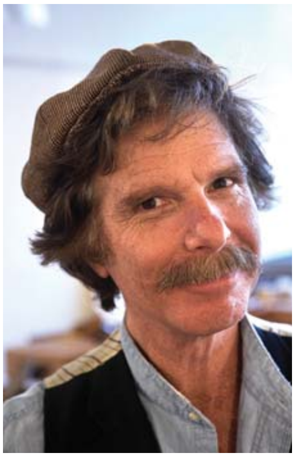


Roy Underhill
"Roubo's Folding Bookstand," page 34.

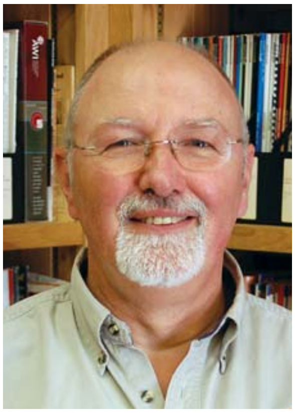
Roy Underhill is the host of the PBS show "The Woodwright's Shop," which is now celebrating its 30th season – that makes it the longest-running "how-to" show on television.

Since the show's inception, Roy has championed the use of traditional handtools and techniques, and has featured guests ranging from well-known woodworkers including Michael Dunbar, Stave Latta and Frank Klausz to specialist artisans in blacksmithing, cooperage and more.

In this 30th anniversary season, Editor Christopher Schwarz is featured in two episodes: one on the three kinds of saw cuts, the second on an 1839 tool kit (check your local listings!).

Plus Roy explores the life and work of Thomas Day, who we featured in our April 2010 issue (#182).

▶ *To read more about Roy and his new woodworking school in Pittsboro, N.C., visit woodwrightschool.com.*



Michael Fortune
"Three-legged Occasional Table," page 26.

Michael Fortune, who lives and works in Lakefield, Ontario, is among the world's most respected contemporary furniture designers. His work has appeared in numerous international exhibitions and is in several permanent museum collections. He's also taught at many schools and conferences. In 1993, Michael received the Prix Saidye Bronfman, Canada's most prestigious fine craft award – the first time a woodworker had been accorded the honor.

Michael primarily designs and makes studio pieces for clients in the United States and Canada, but he also designs products for manufacture in wood, and trains the makers in developing economies including Belize, Mexico and Guyana.

▶ *To read more about Michael and to see a gallery of his work, visit michaelfortune.com.*

Glen D. Huey
"Upgrade Your Cutterhead," page 42.

Glen D. Huey has been contributing to *Popular Woodworking Magazine* since 1997, when we published his curly maple (big surprise!) hanging corner cupboard in the November issue (#99). He joined the full-time staff as a senior editor in 2006, and since then he's been our go-to guy for all things power tool (even though some people don't realize that he also wields a mean dovetail saw).

For the Line & Berry chest that was pictured on the cover of the December 2010 issue (#187), Glen developed router patterns and employed a variety of power-tool techniques to achieve a traditional inlay look. He's filmed a DVD on the process, and it's now available at ShopWoodworking.com.

▶ *To find links to all of Glen's books and DVDs, visit popularwoodworking.com/feb11.*

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ON THE LEVEL

BY CHRISTOPHER SCHWARZ, EDITOR

What's a Workbench Worth?

In 2005, I loaned my French workbench to a friend to use in his booth at a woodworking show. As I rolled the 350-pound behemoth onto the show's floor, I heard a couple wolf whistles (really?), then one of the show's vendors stopped me.

"How much for the bench," he asked. I didn't know what to say, and I just looked confused.

"Would you take $5,000?"

When I recovered my wits I declined the too-generous offer and kept rolling forward.

Though I've built more workbenches than I can keep track of, I've never sold a one. Instead, I give them away to friends and family.

My dad has my "Power-tool Workbench" that I built in 2002. My best friend has my Nicholson workbench from my book "Workbenches: From Design & Theory to Construction & Use." And so on.

When I completed the massive hand-tool workbench on the cover of the August 2010 issue ("The Return of Roubo," #184), I already had someone in mind as I chopped every mortise and sawed the enormous sliding dovetails.

My 9-year-old daughter, Katherine, has a natural knack for the craft. The first time I showed her how to sharpen her block plane, the results were perfect. I'm not that great a teacher, but she had watched me enough that she practically had the skill already soaked into her hands.

She's begged me to let her use the 18-gauge brad nailer (don't tell her mother, but I caved and let her).

Last fall she took her Millers Falls block plane to school when she had to give a report to the class on one of her favorite things. Heck, she does her homework every night on one of my sawbenches.

So in October, Senior Editor Glen D. Huey and I drove my newest workbench from our shop in Cincinnati to my home in Northern Kentucky while Katherine was in school.

We put the workbench in my sunroom then returned to work.

That evening as I was pulling into my driveway, my cell phone rang. It was Katherine, and she was calling me from the sunroom.

I got out of my car and could see her through the windows, holding the phone to her ear and standing before the huge workbench, which she had helped me assemble on weekends.

"Dad, what's this workbench here for?" she asked.

"It's for you, sweetie," I replied.

"Really?" she said. I could see her jumping up and down in the sunroom and skipping up to the massive leg vise screw to give it a spin.

"Thanks Dad!" she yelled.

A few seconds later I walked through the door and got the fiercest hug her 9-year-old arms could muster.

And that is why I'll never sell one of my benches. **PWM**

PHOTO BY AL PARRISH

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Safety is your responsibility. Manufacturers place safety devices on their equipment for a reason. In many photos you see in *Popular Woodworking Magazine*, these have been removed to provide clarity. In some cases we'll use an awkward body position so you can better see what's being demonstrated. Don't copy us. Think about each procedure you're going to perform beforehand.

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In the war against splinters, there is folklore (moistened bread removes splinters) and there are good tweezers.

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— Christopher Schwarz

PHOTO BY CHRISTOPHER SCHWARZ

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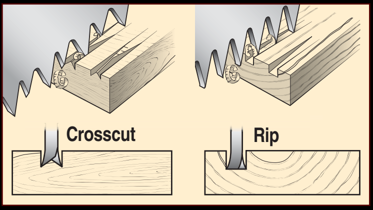

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Milling for Benches

I am planning on building a Roubo-style bench, thanks to inspiration from *Popular Woodworking Magazine* – and a downed tree.

We had an ash tree come down on my family's farm last year from old age and wind. I cut a log 32" x 10' out of it, and a local orchardist has a sawmill and will cut it to my specifications. Those specifications are my question to you.

For the top, I am thinking of having a 6"-thick slab cut full width, then the edges ripped to square it up. Is there a grain orientation that is better than the others? I think that avoiding the center of the tree as part of the slab would be ideal from a movement-prevention and cracking perspective – is this correct? So how far away from the center should I have the slab cut?

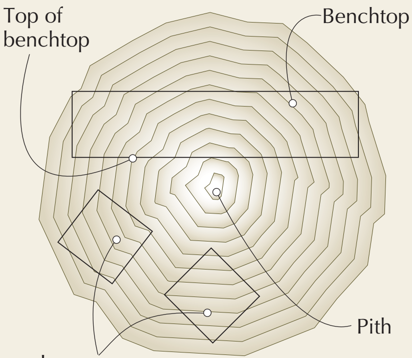
For the balance of the log, I plan on having wood cut for legs, as well as some standard dimensional lumber.

Any help based upon your experience would be much appreciated.

Robert Troup
via e-mail

Robert,
Lucky you!

As to cutting the top, definitely avoid the pith, which is unstable and will result in a lot of splits in your top. I'd have the sawyer cut it directly adjacent to the pith so you can get the widest board possible. By the way – be sure to orient the top so that the heart side is the top surface of the benchtop. That way, if the top piece casts it will bear down on the legs and keep that connection tight.



Legs – growth rings should run diagonally from corner to corner

As to the legs, the best grain orientation is to have the growth rings running diagonally from corner to corner. This results in legs that have the same bastard grain pattern on all four faces of the leg.

Once you get the components milled up, the real challenge will be drying them. You might ask around to see if there is a kiln that is willing to deal with such thick stuff (many are not). If you have to air dry it, make sure it is well stickered and that you coat the end grain with one of the commercial treatments to retard checking (some people just use paint). And be prepared to wait. The rule of thumb is to wait one year per inch of thickness.

Christopher Schwarz, editor

How to Cope: Push or Pull?

With a coping saw, do you insert the blade to use it with a push cut or a pull cut?

Russell Pitner
Hixson, Tennessee

Russell,
Coping saws can go either way, and I use them both to push and to pull. I make the decision as to which way the blade faces based on the work at hand.

The thing to remember is that any tearing is going to occur on the side of the work where the cutting tooth is exiting. So when you pull the coping saw to cut, the tearing (and the sawdust) will occur on the side facing you. When you push the saw, the tearing (and the sawdust) will occur on the side of the work that is away from you.

So when I am cutting a fretwork pattern, for example, I want to follow the lines as closely as I can so I will push the saw so the tearing and sawdust happen on the side that I cannot see.

When I'm removing waste from dovetails or any other joint, I'll use a pull stroke because the tearing will be only in a waste area.

Christopher Schwarz, editor

Twin-screw Vise Hole Locations

Soon, I'll build a twin-screw vise that will go on an English workbench I'm building. What I can't figure out is the vertical placement of the holes on the vise's jaw. I think I read something to the effect that a vise's gripping power increases when the vise screw is lower.

So, for example, if my vise's jaw is 6" in width, and the vise screws and holes are 1½" in diameter, would I get more strength from the vise if I were to drill the jaw's hole below the halfway mark on the jaw? (For what it's worth, the length of the jaw is 33½", and I'm planning for 24" between the screws.)

Jacquelyn Griffin
Houston, Texas

Jacquelyn,
With a twin screw, the vertical placement of the holes doesn't really do much to change the gripping power of the vise. Their placement does, however, determine how much the jaw will rack vertically. And vertical racking can make it hard to pinch narrow stock at the top of the vise.

So here's the principle: The closer to the top you can locate the holes for the screws, the less vertical racking you will experience and the better you will be able to grip narrow stock in the jaws. Some bench makers will even tap the benchtop itself to get the vise screws within 1" or so of the benchtop. That, however, is quite a lot of work.

In my bench with a homemade twin-screw, I have the vise screws about 3" down from the benchtop, and it will rack a bit and be fussy with really narrow stock. When that happens, I simply take the stock out of the twin-screw and pinch it between dogs on the benchtop.

Bottom line: The screw placement does change how the vise works, but there are easy work-arounds.

Christopher Schwarz, editor

CONTINUED ON PAGE 12

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CONTINUED FROM PAGE 10

Aftermarket Plane Blades

I have a nice Stanley No. 6 fore plane made in Sheffield, England, and I need to replace the blade.

In my experience, thicker blades such as those made by modern blade makers are better than standard Stanley blades.

The solution I have is to enlarge the mouth of the plane.

The question is, after widening the mouth, will a thicker aftermarket blade fit, and is the aftermarket blade geometry the same, or will I need a new chipbreaker, too?

Stavros Charalambidis
Thessaloniki, Greece

Stavros,
The answers depend on your plane in particular. Some planes can accommodate aftermarket blades with no problem. Others have difficulties.

The key is the height of the little square dog that sticks up from the frog of the tool. Is it tall enough to reach through the thicker aftermarket blade and engage the chipbreaker? If so, then you are in good shape. If it's not, then you want to invest in an aftermarket blade that is the thickness of your original blade. Several manufacturers sell these thinner blades.

If you can install a thicker blade in your plane, you might find out that the blade will not extend out of the mouth – no matter how far back your frog is. This means you need to file the front of the mouth open – an easy operation. Mark a line forward of the mouth, clamp the plane in a vise and file to the line. Test your blade in the plane. Repeat this filing and testing process until the plane works as you like.

An aftermarket chipbreaker is always a nice improvement compared to the springy factory ones. They are not, however, required when you install a new blade.

Christopher Schwarz, editor

> *"High technology has done us one great service: It has retaught us the delight of performing simple and primordial tasks – chopping wood, building a fire, drawing water from a spring."*
>
> — Edward Abbey (1927-1989)
> American writer

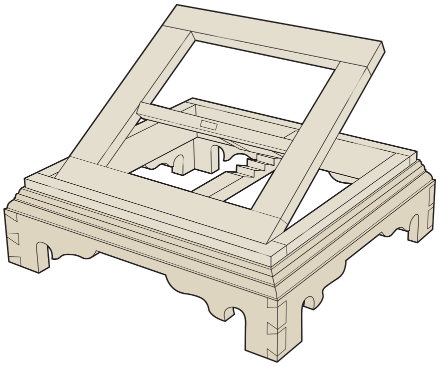
How to Make William & Mary Bookstand Feet Without a Lathe

I would like to build the William & Mary bookstand (November 2010, #186), but I don't have a lathe. Can you suggest a way to make the feet without turning them?

Robert Ragland
Arlington,Texas

Robert,
There are a couple ideas that could lend themselves well to this piece.

First, how about creating the same profile, but making the feet square instead of rounded?



To do this, make a pattern of the drawing, transfer that to your foot blank and cut the profile at a band saw (save the offcuts). Then, tape the waste back in position, mark the pattern a second time on the remaining faces (similar to how one would cut a cabriole leg) then cut the last sides. The profile will be shaped like the turned foot in the article, but it's square.

A second option is to purchase a turned finial then cut off an appropriate length and shape the resulting cut. Or purchase four turned feet. Finials and feet are available through a number of suppliers, including Rockler (rockler.com) and Van Dyke's Restorers (vandykes.com).

Or, instead of a turned foot, use a small bracket-style foot to complete the bookstand, as shown above.

I'm sure there are more options. I've even heard of woodworkers using a drill press for turning small parts, but there is a lot of setup in that. **PWM**

Glen D. Huey, senior editor

Correction: An electronic glitch scrambled the cutlist for the William & Mary Bookstand featured in Arts & Mysteries in the November 2010 issue (#186). It should have appeared like this.

William & Mary Bookstand

	NO.	ITEM	DIMENSIONS (INCHES) T	W	L	MATERIAL	COMMENTS
☐	4	Outer frame	3/4	1 3/4	12	Walnut	
☐	1	Support top rail	5/8	1 3/8	10 1/2	Walnut	
☐	1	Support bottom rail	5/8	1 3/8	11 1/2	Walnut	1/2"-long, 1/2"-round tenon
☐	2	Support stiles	5/8	1 3/8	9	Walnut	3/4" TBE*
☐	1	Sawtooth leg	5/8	7/8	12	Walnut	
☐	1	Support leg	5/8	7/8	4 5/8	Walnut	5/8" TOE**, TOF†
☐	1	Frame pivot	5/8	5/8	8 3/4	Walnut	1/2"-long, 1/2"-round tenon
☐	4	Feet	1 5/8	1 5/8	2 1/8	Walnut	

* tenon both ends; ** tenon one end; †taper one face

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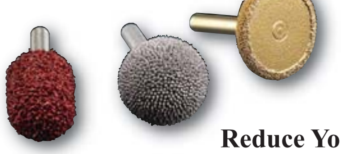

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EDITED BY KARI HULTMAN

THE WINNER:

Dado Width Adjustor

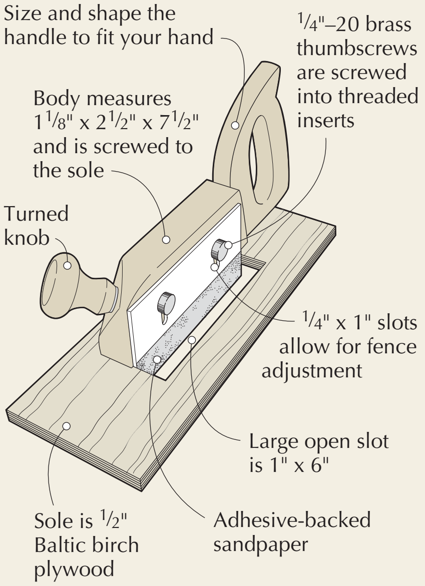
I cut dados for a tight fit. When I make them too tight, I use a jig that I call a Dado Tuner.

The sole is ½" Baltic birch plywood, measuring 4½" x 12"; the open slot is 1" x 6"; and the adjustable sanding fence is 3" x 6". The body and handle were shaped from one piece of 1⅛" hardwood. The portion of the body to which the fence is attached measures 2½" x 7½". The handle is sized to fit the user.

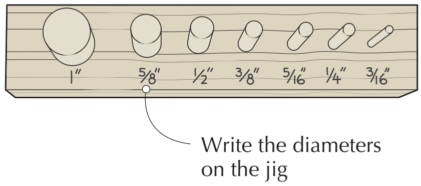
The turned knob is offset to the right to help maintain pressure as the sandpaper is pressed against the dado's wall.

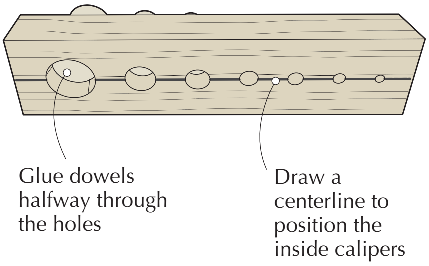
The sanding fence is made from ⅛"-thick white hardboard, which is available from big box stores. Its shiny surface makes it easy to adhere and remove adhesive-backed sandpaper. The fence is held to the jig's body with ¼"-20 knurled brass thumbscrews that are screwed into threaded inserts. The slots in the fence are a little more than ¼"-wide and 1"-long.

To use the jig, place it on top of the dado, loosen the brass nuts and slide the sanding fence into the dado until it sits flush with the bottom. Tighten the nuts, press the sandpaper surface against one wall of the dado, and slide the jig from one end of the dado to the other. A few quick strokes increases the dado's width, and the wall will be evenly sanded from top to bottom and along its length.


Size and shape the handle to fit your hand
¼"–20 brass thumbscrews are screwed into threaded inserts
Body measures 1⅛" x 2½" x 7½" and is screwed to the sole
Turned knob
¼" x 1" slots allow for fence adjustment
Large open slot is 1" x 6"
Sole is ½" Baltic birch plywood
Adhesive-backed sandpaper

Don Henderson
Orleans, Ontario




Glue dowels halfway through the holes
Draw a centerline to position the inside calipers

Woodturning Caliper Gauge

I created a jig that allows me to set calipers quickly for holes and dowels.

The jig is a thick piece of scrap wood with through-holes bored at a drill press. Draw a centerline along the length of the scrap wood, then drill hole sizes that meet your needs on this line. On the opposite side of the jig, glue a dowel of the corresponding diameter halfway into each hole, leaving the bottom half of the holes clear. Write the sizes of the holes and dowels on the jig, and you're done.

To use the jig, set the inside and outside calipers to whichever hole or dowel is needed. For inside measurements, use the line that you drew on the jig to position the calipers.

Charles Mak
Calgary, Alberta

Magnetic Featherboard

I have always made my featherboards out of scrap material. This required using other scrap pieces as braces that were long enough to be clamped to my table saw. Now, I use multipurpose magnet holders (also called welding magnets) to position featherboards wherever I need them. No clamping is required.

First, trace an outline of the magnet's base on the featherboard. Drill holes on either end of the outline and remove the remaining waste with a jigsaw. Make sure the magnet fits loosely enough in the hole so that you can feel it grip squarely on the tabletop.

Two additional magnets are used as braces. The thickness of your featherboard should match the height of the notches in the magnets so the magnets rest firmly on top of and against the featherboard. This ensures that the featherboard will not lift off the table.

Michael Cyr
Westport, Massachusetts

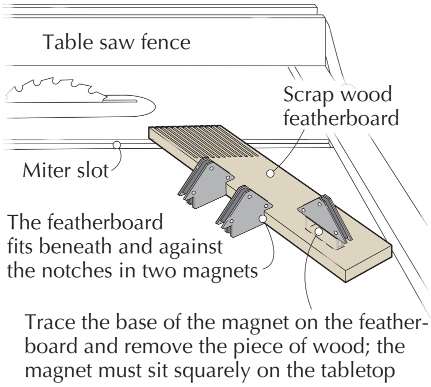
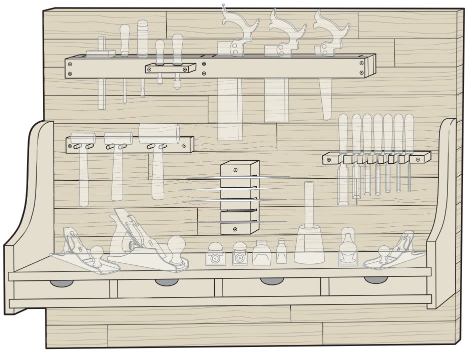


Table saw fence
Scrap wood featherboard
Miter slot
The featherboard fits beneath and against the notches in two magnets
Trace the base of the magnet on the featherboard and remove the piece of wood; the magnet must sit squarely on the tabletop

ILLUSTRATIONS BY MARY JANE FAVORITE



Floorboards for Tool Storage

I had some leftover $^{3}/_{4}$" prefinished hardwood flooring that I decided to attach horizontally to my shop wall. It replaced the deep-door, hanging tool cabinet (which was never shut anyway). Now, all my tools and tool holders are attached to the floorboards for easy access. My planes sit in a row, at the ready, on a long shelf that's screwed to the boards.

The wood flooring looks great on the wall and provides well-anchored support for my tools.

Jameel Abraham
Cedar Rapids, Iowa

Trick for Drilling Perpendicular Holes

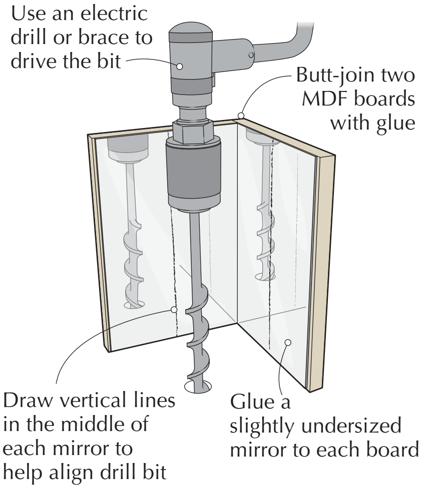
Here is a trick that I've developed to help keep holes perpendicular to the surface when drilling by hand, either with a brace and bit or with an electric drill.

I'm not very good at lining up my drill with a try square, so I made a fixture that I call a "mirror gauge." It's made from two pieces of $^{1}/_{2}$" MDF – one board is 5" x 7" and the other is 5$^{1}/_{2}$" x 7". The two pieces are butt-joined with glue at a 90° angle.

Cut two pieces of inexpensive mirror slightly smaller than the boards, then glue them to the faces of the MDF with mastic or mirror adhesive. I drew perpendicular vertical lines in the middle of each mirror with a marker. The lines provide a reference so you can see when the bit is perfectly straight.

You can also use the mirror gauge for squaring chisels when dovetailing or mortising.

Walter Lees
Tempe, Arizona


Use an electric drill or brace to drive the bit
Butt-join two MDF boards with glue
Draw vertical lines in the middle of each mirror to help align drill bit
Glue a slightly undersized mirror to each board

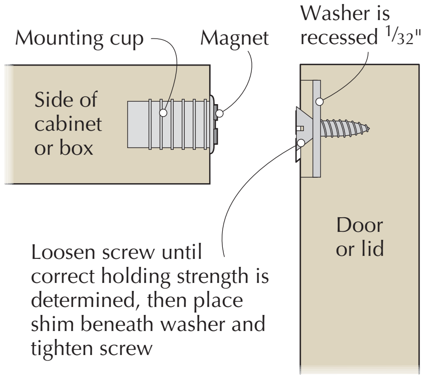
Adjustable Magnetic Catch

Round magnetic catches (Rockler #29280) and cupped magnet catches (Lee Valley #99K39.04) are convenient devices for securing lids on boxes or cabinet doors. However, many times the magnetic attraction is too strong, and excessive force is needed to open the lid or door. Here is a simple way to adjust the holding power.

The typical round magnetic catch consists of a magnet (in a mounting cup) that is attracted to a washer (which is screwed to the opposing piece). The holding strength varies as you increase or decrease the gap between the magnet and washer.

Use a Forstner bit in your drill press to carefully drill the mounting cup hole so that the top of the cup is flush with the wood's surface. Use a cardboard shim if you drill too deep. Install the cup in the hole. Don't put the magnet in the cup yet; once it is seated, it cannot be removed.

Next, put a dowel center in the mounting cup to locate the position for the washer and screw. Drill the hole so that the washer will be recessed about $^{1}/_{32}$" and fasten it with a screw. Then, put the magnet in the mounting cup and test the hold. It should be weak.


Mounting cup
Magnet
Washer is recessed $^{1}/_{32}$"
Side of cabinet or box
Door or lid
Loosen screw until correct holding strength is determined, then place shim beneath washer and tighten screw

As you loosen the washer's screw in small increments, the hold of the magnet will increase. This is because the gap between the magnet and the washer is decreasing. By trial and error, find the best hold. If necessary, deepen the hole. Then, remove the washer and cut an appropriately sized shim from cardboard or foam to fit beneath it, and remount the washer. **PWM**

Al Goldstein
Ann Arbor, Michigan

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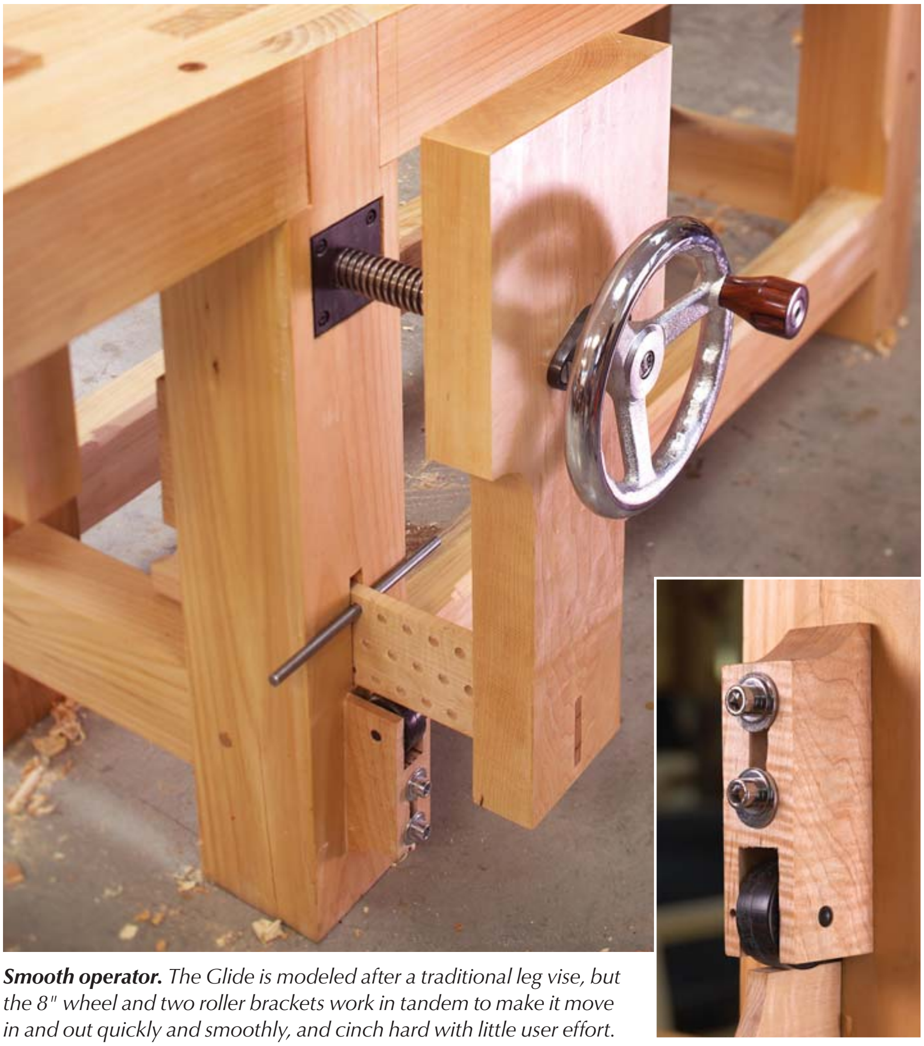
Runners-up each receive a check for $50 to $100. When submitting a trick, include your mailing address and phone number. If your trick is selected, an editor will need to contact you. All entries become the property of *Popular Woodworking Magazine*. Send your trick by e-mail to popwoodtricks@fwmedia.com, or mail it to Tricks of the Trade, *Popular Woodworking Magazine*, 4700 E. Galbraith Road, Cincinnati, OH 45236.

BY THE EDITORS

Benchcrafted Glide Vise

Machined to the nth degree, this leg vise clamps like a champ.



Smooth operator. *The Glide is modeled after a traditional leg vise, but the 8" wheel and two roller brackets work in tandem to make it move in and out quickly and smoothly, and cinch hard with little user effort.*

The Benchcrafted Glide Leg Vise takes its design cues from a traditional leg vise with a wooden screw, but this contemporary iteration works more smoothly, easily and quickly. And it cinches down hard on a workpiece with little torquing effort by the user. Benchcrafted calls it "effortless workholding" – and that's true, once you get the Glide properly installed. It's a little more work than installing a wooden screw but once you're done, this vise is a joy to use.

With a traditional screw, you simply cut a through-hole in your bench leg and seat a threaded block in a notch at the back of the leg (and install a garter, if you choose), cut a through-mortise for the parallel guide, then the work on the leg is complete. (With both the Glide and a traditional vise, you also, of course, have to make the chop and parallel guide.)

Glide installation also requires you to mortise a recess and install an acetal bushing for the screw, and cut, assemble and install two blocks to hold the "roller system" – two ball-bearing wheels between which the parallel guide runs. This system helps to support the weight of the chop, which alleviates friction on the screw and allows it to move freely with just a spin of the 8"-diameter cast iron wheel. (The wheel I installed is chrome plated with a rosewood handle, but, by customer demand, Benchcrafted's new wheels will have black coated, cast iron spokes with a satin polished finish on the rim.)

The extra steps took only a few hours, however, and the instructions are straightforward and easy to follow (and include full-size templates for the roller guides and parallel guide hole locations).

Although I've been using the Glide for a few months now, I'm still astounded every time I spin the wheel (yes, you can actually spin the wheel to move the chop in and out). The $1^1/_4$", 4 tpi carbon steel screw (secured at the back of the leg through a black, enamel-coated steel flange) moves unbelievably smoothly, and it cinches the chop hard on the work with almost no effort on my part. Plus, the assembly adds a lot of needed weight (and a bit of bling) to my white pine bench.

The Glide, which is made in the United States, comes with all necessary hardware and parts (including a parallel guide pin); you supply the wood for the chop, parallel guide and roller brackets.

— Megan Fitzpatrick

Glide Leg Vise

Benchcrafted ▪ benchcrafted.com

Street price ▪ $339

▶ **BLOG:** *Read more about Benchcrafted at benchcrafted.blogspot.com.*

Price correct at time of publication.

CONTINUED ON PAGE 18

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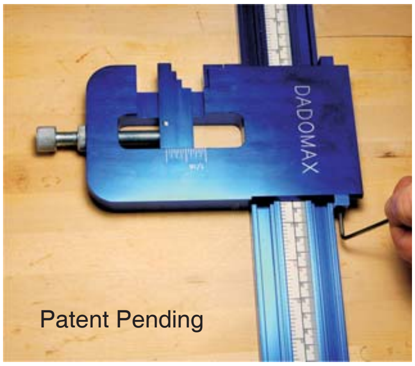

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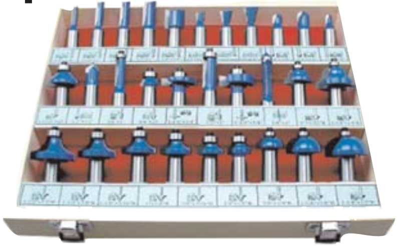

5 Straight, 6 Roundover,
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3 Cove, 2 Flush Trim, 1 Panel Bit,
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EP7	7” Ebony Plane	1 3/4” X 3 1/8”	39.95
EP4	4” Ebony Plane	1 3/4” X 2 7/8”	34.95
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ERP600	6” Rabbet Plane		29.95
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CONTINUED FROM PAGE 16

A Fusion of Saws & Colors

Grizzly's newest hybrid table saw is from the Polar Bear series. It's priced under $800, and that's seldom seen these days.

The G0715P has a fully enclosed cabinet for better dust collection and a 2-horsepower motor that's tucked inside the cabinet. It's the table-mounted trunnions that reveal its contractor saw heritage.

The saw is wired for 220-volt electric, but it can be converted to 110v if your shop lacks the higher voltage. To convert, change a couple wires and replace the circuit breaker at the switch (which I'm told you don't really need to do). You'll also have to change the plug.

G0715P has a shielded blade guard system and a true riving knife. To change setups, release a locking pin through a hole in the table insert. It's easy, but I'm not fond of working through an insert that cannot be removed with the guard in place.

The 1/8"-thick insert makes it difficult to produce shop-made zero clearance inserts but they are available from the company. The fence has multiple adjustment points that all need to be adjusted to dial in a perfect setting.

The power of the G0715P, when using a thin-kerf blade to match the supplied riving knife, equates with other hybrid table saws. A full-thickness riving knife is an accessory.

If you're in the market for a hybrid table saw, the G0715P is a good value.

— Glen D. Huey

10" Hybrid Table Saw

Grizzly Industrial, Inc. ■ grizzly.com
or 800-523-4777

Street price ■ $758

BLOG: *Read more about the Polar Bear Series at popularwoodworking.com/feb11.*

Price correct at time of publication.

Crank Up Your Router

Back in the day, you had to remove your router from the table to change bits, and fine adjustments required twisting the tool while under the table. Later, lifts were raised or lowered to gain access to the collet and dial in the needed height via a ratcheting system from above.

Some time back, Woodpeckers delivered a router lift that allowed quick elevation adjustments and a way to fine-tune settings with a thumb-turned wheel, but to the company that wasn't good enough. Today there's a new lift from the team at Woodpeckers. It's called the Side Winder Router Lift.

This lift maintains the "Quick Lift" feature found on Woodpeckers' earlier lifts–a spring-assisted wrench reaches through the table to unlock then lift or lower the router unit. With the router rough set, fine adjustments are made with a crank handle mounted elsewhere on your cabinet.

The handle attaches through a mounting plate, and meets up with a 3/8"-diameter flexible shaft that fishes through a sleeve bearing which is then coupled to a 32-tpi lead screw. The fine pitch design makes big changes snail-like, but it's a snap to micro-adjust to a perfect setting.

It's important to follow mounting instructions when locating the crank and mounting plate. Location influences workability (it can make it harder to crank) due to how the 28"-long flexible shaft snakes around to make the connections.

The SW350 is for smaller routers with 3 1/2" diameter motors while the larger unit, the SW420, handles larger router motors such as the Porter-Cable 7518. **PWM**

— GH

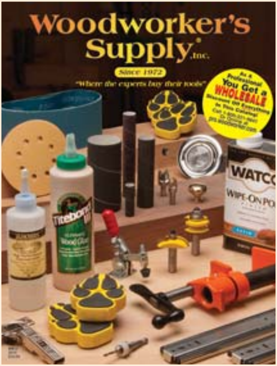
Side Winder Router Lift

Woodpeckers ■ woodpeck.com
or 800-752-0725

Street price ■ SW350 $260
■ SW420 $360

VIDEO: *How to install a router table base plate at popularwoodworking.com/feb11.*

Price correct at time of publication.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DESIGN MATTERS

BY GEORGE R. WALKER

Essential Dividers

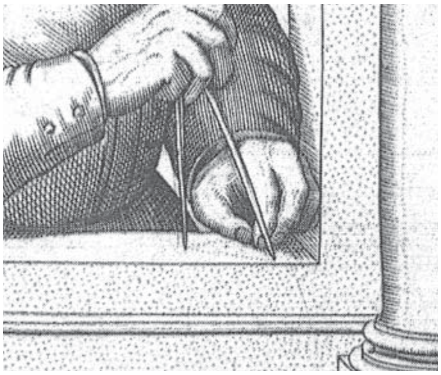
Unlock your creativity with this humble tool.

Time-honored tool. *Dividers were the "go to" design tool for every branch of traditional woodcraft.*

How comfortable would you be giving up your tape measure? If that puts you in a cold sweat, I can relate. Time was when I worked only from prints, taking careful measurements to make accurate parts. I thought design was for the talented few – those folks blessed with a good eye. Here's a little secret: Some are born talented but many acquire design skills much the same way as learning to cut dovetails. It's a matter of building foundation skills and a little practice.

Lesson number one: Get acquainted with your new instructor – the simple, humble pair of dividers. They've been rightly called the "tool of the imagination." In pre-industrial craft, artisans used this simple pair of pointed legs joined at a fulcrum both to explore and apply proportions. Dividers were the stock-in-trade for all the woodworking crafts: carpenter, cabinetmaker, wheelwright and everything in between.

So how did this once-common tool find itself pushed to the back shelf, relegated to little more than a symbol of the craft? Much has to do with a sea change in our approach to design in the modern workplace and the division between designer and artisan. In the pre-industrial workshop, the journeyman or master played a major role in the design process. He not only built the chair or table but worked out the proportions and details with the aid of his trusty dividers. As industrialization and mass production changed the landscape, workers specialized. Design duties shifted toward engineers, while craftsmen increasingly worked to specifications from a drawing. Emphasis shifted from working out the proportions at the workbench to copying numerical measurements and tolerances from a print.



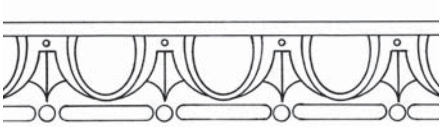
Exploring the past. *Designers used this tool to explore great masterworks.*

Down, But Not Out

Yet somehow dividers held on as a quick and accurate layout tool. My own first professional encounter with dividers came 35 years ago when I entered a formal apprenticeship to become a machinist. We started with a small kit that included some layout tools. Among those was a shiny pair of 6" (length of the legs) Starrett dividers. I quickly learned basic layout skills not unlike many of the methods used to lay out wood. The metal was painted with a blue or red dye and layout lines were scratched on the surface.

Dividers were used in tandem with a precision scale. Referencing a drawing, the points were adjusted to the markings on a ruler then transferred to the work, accurately marking circles or locations for drilling holes. Still, this is a modern adaptation, a simple data transfer from someone else's design. It's more like using dividers to play a musical recording – far short of actually creating music.

PHOTOS & ILLUSTRATIONS BY THE AUTHOR (EXCEPT FOR PUBLIC DOMAIN IMAGE "EXPLORING THE PAST")



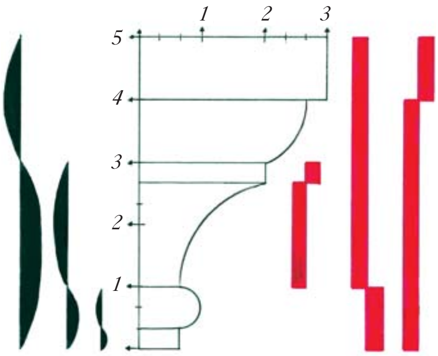
Simple steps. *Stepping off repeat elements such as these egg-and-dart carving patterns is made simple with dividers.*

Keys to the City of Proportions

Dividers are the key to understanding proportions then applying that knowledge to your own work. In simplest terms, proportions are how one part relates to another and how it relates to the whole. Proportions are about creating a harmony or unity so all the parts flow together visually.

Pre-industrial artisans used proportions to organize a design, often expressed in simple ratios laid out with the aid of a pair of dividers. Here's a great example. The drawing of a complex moulding profile (above right) is based on a design by James Gibbs (circa 1732). Note the lack of dimensions – only simple divisions. This moulding could be 2" high or 12. What is important is that these divisions are key in understanding how the parts are sized or proportioned in relation to each other. The overall height is divided into five parts and the width into three. Note that some of those major divisions are again sub-divided further.

For such a simple moulding there is a lot going on proportionally. On the left I've indicated how the parts are divided into major and minor elements, one part complementing the other. On the right I've indicated with the red bars how proportions are used to punctuate. Punctuation is used to create a beginning, ending or border. Step these off with dividers and see if you can uncover the proportions.



Proportional points. *This complex moulding profile is organized around simple proportions stepped off with dividers.*

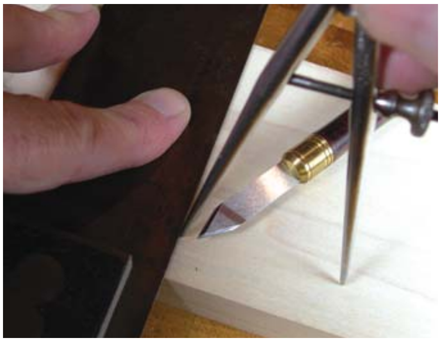
Tracking use. *Using two different-sized tools helps to keep track of important settings.*

Every element in this form is proportionally linked to its neighbor as well as to the whole. Aspiring designers were traditionally encouraged to explore known works with proportional excellence in order to train the eye. This knowledge then became second nature.

Application

I have a good-sized coffee can in my shop filled with dividers but in reality most work is done with just two sets or pairs of dividers: 6" and 4". I use two distinct sizes for a reason. It always seems one ends up set to a proportion I want to come back to, and the other is available to adjust and work out a design. Using two sizes helps me keep track of which is which.

You can easily sharpen divider points on a piece of sandpaper or a sharpening stone. It's also helpful when buying dividers to check to make sure the points are equal in length. If they are off, grind them the same length and re-sharpen. Actually, unless you drop them on concrete, they can go many years without a touch-up.



Negative points. *Pressing the dividers into the work creates an indent for the marking knife.*

Avoid extending the points much beyond 45°. You lose accuracy when the points engage at much beyond that angle. If you need to step off large divisions, switch to a larger tool or simply double the divisions. Instead of stepping off four times, try eight. For stepping off repeat elements such as an egg-and-dart carving pattern or a string of dovetails on a wide blanket chest, nothing comes close.

They can be tweaked ever so slightly to shrink the pattern or stretch it to perfectly match the workpiece. You can adjust a pattern so it comes up to a mitered corner with a nice transition and not at an awkward random spot.

Finally, divider points can be pressed into the work to provide a small indent which acts as a register for a pencil or marking knife. No doubt this was important in the pre-industrial shop under poor lighting, but I find it helpful today when my eyes struggle to see detail even under gobs of wattage.

Something wonderful happens when you start exploring with dividers and using them to lay out proportions in a design. You'll find yourself thinking and seeing proportionally – a sure sign your eye for design is awakening. **PWM**

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If you have a thirst to hone your creative skills, Design Matters dives into the basics of proportions, forms, contrast and composition to give you the skill to tackle furniture design challenges with confidence.

BY BOB ROZAIESKI

Replace Your Tailed Router

Stop the screaming once and for all.

Plane and simple. *Make some mouldings with a well-tuned plane and you'll wonder why routers were ever invented.*

When I first started using hand tools, I was hesitant to let go of my router. I had no love affair with the screaming beast. We weren't even good friends. We just called on each other when we felt that need to … make moulding.

Let's face it. It's tough to beat a router at cranking out moulding. For the woodworker on a budget, the big shaper with custom cutters won't give us the time of day. So the router becomes the go-to tool.

But as most make-do relationships go, we tire of the screaming, constant mess and inadequate performance. This leads to periods of inactivity, neglect and, ultimately, designs devoid of the shapely features we once knew.

Find Your Sole Mate

When I finally had enough of the screaming, I discovered moulding planes. If you're a relatively new hand-tool addict, beware these hand-tool sirens. After using a well-tuned moulding plane, their calls become difficult to resist.

There are two general types of moulding planes: simple and complex. Simple moulding planes make a single curve (e.g. hollows and rounds). Complex moulding planes make complex shapes such as ogees and quirked beads. The type chosen is based largely on the size and shape of the moulding, how much moulding is needed and if an existing profile must be reproduced.

For a single piece of moulding, both types of planes work well. For making multiple pieces of the same profile, complex moulders get the call. It's difficult to make two identical mouldings with hollows and rounds.

On the other hand, complex moulding planes are efficient for profiles only up to about 1" wide or so. Not only is it difficult and expensive to find very wide profiles, they also require a team of oxen to pull. For wide mouldings, like those of a cornice, it's easier to build the moulding up from smaller profiles or to use hollows and rounds. Hollows and rounds are also the only real way to make a reproduction of an existing moulding.

Start Simple

A good way to begin using moulding planes is with hollows and rounds. Not only are they the most commonly found, they're also the easiest to put back into service. Complex profiles require more care and work.

Acquiring moulding planes takes patience. They are common in the wild, but often in rough shape. It is possible to perform an extreme makeover, but it's not recommended if the goal is just to acquire a few users. Stick to examples that are relatively clean, with no dry rot, little pitting on the iron and no major warping. An out-of-flat sole can be trued, but avoid side-to-side warp.

Give 'Em a Minor Facelift

Begin the makeover with a light cleaning using a Scotch-Brite pad, dish soap and warm water. Don't soak it; just clean off the grime. Once clean, allow the plane to dry thoroughly and apply a coat of wax.

Next, inspect the wedge. It should fit snugly and hold the iron firmly. If the iron slips, the wedge may be improperly fit or the stock may have shrunk. Correct the wedge before going any further. A light sanding or scraping of the sticking spots is all that's required.

Now wedge the iron in place and check

PHOTOS BY THE AUTHOR

the straightness of the sole. Chances are, it will be out of flat and the profile may need truing. The hollow is the easiest to do first.

The profile of the planes shown here is one-sixth of a circle. That means the width of the iron should correspond to the radius of the curve. This may or may not be the case, depending upon who manufactured the plane. There was a lot of inconsistency between makers.

I like to correct my hollows and rounds so the width of the iron equals the radius of the curve. I feel it's easier to choose the proper plane for a moulding when I know its radius.

Use an appropriately sized dowel to correct the profile of the hollow plane. Wrap the dowel tightly with #150-grit sandpaper and carefully sand the sole to the proper profile. Be careful not to rock side to side, and keep even pressure from above. If done carefully, this will straighten the sole and correct the profile at the same time.

With the sole trued, turn your attention to the iron. Lap the face to remove pitting. Then paint the face with a magic marker or layout fluid. Wedge the iron in place, projecting slightly from the mouth, and scribe the profile of the sole onto the iron. Shape the iron to the scribe line at the grinder, or with sandpaper wrapped around a dowel.

After shaping, re-establish the bevel at the grinder, or with the dowel and sandpaper. Then hone the edge with slipstones or finer sandpaper. The final shape of the iron should be similar to a smooth plane with a slight camber. The shaving should be thickest in the center and feather out to nothing at the edges. This prevents the corners of the iron from gouging the stock and permits planing right into a corner.

Once the hollow is tuned, it's easy to true the sole of the mating round by planing it with the hollow. Once the sole of the round has been trued, scribe, reshape and hone its iron in the same way as the hollow. A flat grinding wheel and bench stones can be used here.

Feed Your New Addiction

Once the planes are tuned up, try them out by making a simple moulding. Draw the profile on the end grain, use a rabbet plane to create steps almost to the pencil lines, then plane the curves with the hollow and round. After tuning a few simple moulding planes, moving on to the complex shapes will be a breeze. Just don't be surprised when you need to expand your shop as a result of your new habit. **PWM**

Bob has been building furniture for almost two decades, and 10 years ago decided to use hand tools only.

Hardware store fix. *I use a selection of dowels and other profiles to correct my planes' soles. This works for hollows and rounds, as well as more complex shapes.*

No bananas please. *Use light pressure and check the profile and straightness often to avoid making the sole convex. Pencil lines help gauge your progress. The finished profile should match the dowel curve and be straight from heel to toe.*

Transfer the profile. *I use an awl to transfer the shape of the sole to the layout dye on the face of the iron. Grind the edge blunt down to this line before grinding the bevel.*

Radiused wheel makes grinding a breeze. *I used a wheel dressing tool to round this 3/4"-thick grinding wheel to about a 3/8" radius. This allows me to grind hollow irons down to about 1/2" wide. A 1/4"-thick grinding wheel handles smaller irons.*

Plane the plane. *The hollow is the negative of the matching round, so it can be used to true the sole of the round. Make very light passes to avoid planing too much and recheck the sole of the round often.*

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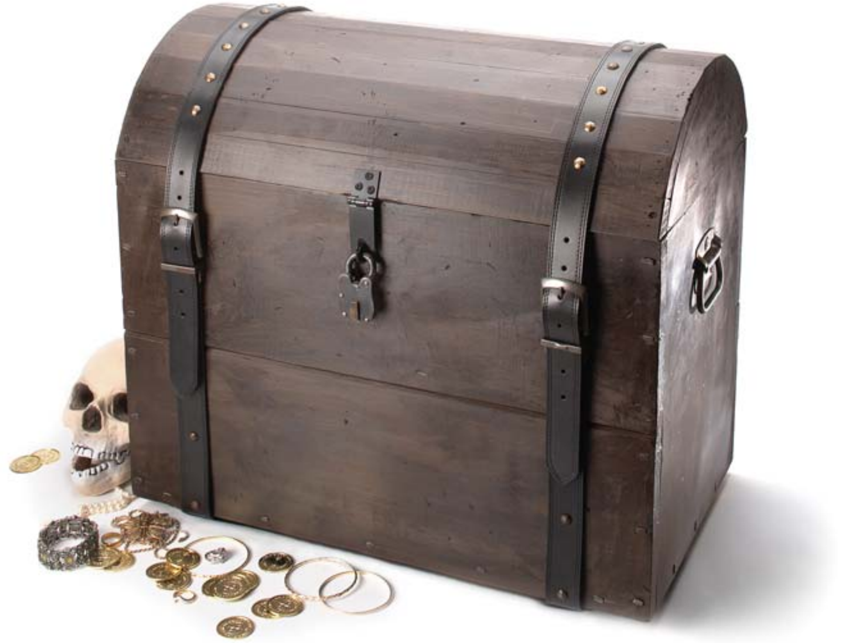
BY MEGAN FITZPATRICK

Pirate Chest

Masonry nails and two XXL leather belts impart the 'arghh!' in this build.



Curve appeal. *This "pirate chest" is really just a simple box. What gives it appeal is the curved top, which is constructed from 12 slats that are shaped with a block plane. (The belts help, too.)*

Don't let the curved top of this "pirate chest" scare you. It's a lot less tricky than it may appear – and it's excellent practice with your block plane.

For this build, you'll have to venture a bit beyond the home center – but stop there to pick up a 6' 1x12, two 8' 1x8s and 21' of 1$^1/_2$" x 1 slats (though if you have a table saw or band saw with which to rip the slats, that will be more economical). Also get 40 or so upholstery nails, a box of at least 40 6*d* masonry nails, a hasp, two 4" gate hinges and two handles. Go for the cheap zinc-coated hardware; I'll give you a few options for aging it. Now, you need to visit a "big and tall" clothing department for some 50" (or better, 60") leather belts. At 50" (the largest available where I shopped), I had to cut the belts and nail them at the front and back edge of the bottom. Just 10 additional inches would have meant no cuts – the belts would have wrapped all the way around (and saved a little time and trouble).

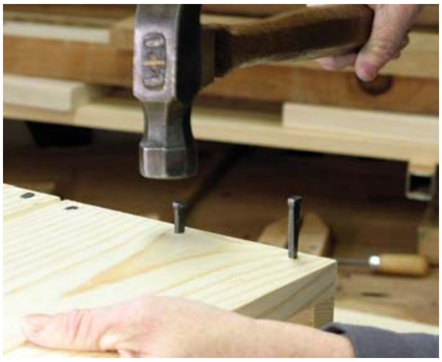
Build the Box First

To make things simple, I used the full width of my stock lumber for the front, back and sides. So I set up a stop at the miter saw and cut the four front and back pieces from the 1x8s to 22" long. Then, I cut the two sides to 14" long – but, because dimensional lumber can vary slightly in width, you should butt the two front pieces (or the two back pieces) against one another, and cut the length of your side pieces to match that measurement.

In other words, it's always risky to rely on the cutlist or drawing for exact dimensions; yours could end being slightly different in any build. Always generate measurements from the actual parts when possible.

Both the front and back have chamfers on the long edges where the two pieces meet in the middle, which serve two purposes: They create a shadow line for a more pleasing aesthetic, and they hide the fact that the two pieces don't form a perfect joint (an impossibility with two home center edges). I simply eyeballed the chamfers using a block plane held at a 45° (or so) angle for each piece, and continued planing until I was content with the chamfer depth. If eyeballing it isn't your style, measure and mark a line across both the face and edge at $^1/_8$" and plane down to your lines.

Now clamp the front and back pieces in place to the sides, then decide on your nail layout (I used on three nails on each plank end: one $^3/_4$" from each edge and one in the middle) and drill $^1/_8$" pilot holes – which seems big, but it isn't. In fact, the wood may still split when you sink the nail – especially if you aren't careful to line it the wide part of the nail in line with the grain. (If you get a split, don't panic. Just pull the nail out and drill a bigger pilot hole.) Masonry nails, like period cut nails, are actually wedges, so if you align them incorrectly, you're basically wedging the wood apart – especially in this case, when you're nailing so close to the end.



No wedgies. *When using masonry nails (or period cut nails) it's important to align the wedge-shaped nail so that the wide part is going with the grain in the top piece of wood. If you align it across the grain, you'll likely wedge the grain right open and cause a split.*

LEAD PHOTO BY AL PARRISH; STEP PHOTOS BY THE AUTHOR; ILLUSTRATION BY ROBERT W. LANG

With the case assembled, cut the bottom to length just a hair undersized at the miter saw, then take a few strokes along a long edge with your block plane. The piece should be a tight fit in the bottom of the case. I knocked it in with a rubber mallet, then put everything on the floor to push the bottom piece firmly in place. Measure, mark and drill pilot holes. I used five nails across the front and back, and three on either side. Locate the side nails in far enough that you won't hit the ones coming in from the front and back.

Do you really need such big nails to hold this small box together? Of course not. And do you really need to use so many of them? Again, no. But the large heads and interesting shape add to the overall look of the chest. It's all about the aesthetics.

Make a Curved Top

First, use a compass to mark the two side pieces for the top with a $5^{15}/_{16}$" radius – or just use a 5-gallon bucket to trace the curve. Either way, the apex of the curve is 4" from the bottom center of the pieces.

Before you start attaching the slats to your top end pieces, you'll first have to plane an angle on at least one long edge of each slat (and on both edges as you round the top). What angle? Well, I eyeballed it. I held my first slat in position at the bottom front edge, and marked an angle on the end that looked as if, once the waste was removed, it would allow the slat edge to sit flat to the top edge of the case. Then, I marked the cut along the edges of the slat, clamped it into position, and used a block plane to plane down to my lines.

Rounding the top. *In the story, you discover two ways to fit the slats for this curved top. No matter which approach you choose, you'll need to plane angles on the slat edges with your block plane to get the pieces to fit.*

I temporarily secured the slat in position to the top end pieces with one 2*d* finish nail at each end, then fit the next slat in the same manner, marking the angle on the edge facing the previous slat while leaving the top edge at 90°, until I came to the two center top pieces. Those must be planed along both long edges. Then, I worked down the other side, with the angle planed on the side facing the back edge of the chest. (Or, you can mark and plane angles on both edges of each piece for a tighter fit, as shown in the drawing.)

Once all the slats are fit and temporarily tacked in place, drill pilot holes for 4*d* finish nails, mark the order in which each slat is attached to the ends, then pull the slats off. Now apply glue to each long edge as you reattach the slats in order using 4*d* finish nails. Use a nail set to set each nail well below the wood's surface (and using an oversized nail set will help you jump-start the "aging" process, by making a bigger indentation, giving the top the appearance of long use and abuse).

Once the glue dries, use your block plane to smooth the arris where each slat meets (double-check first that all your 4*d* nails are below the surface; if they're not, you'll nick your plane blade).

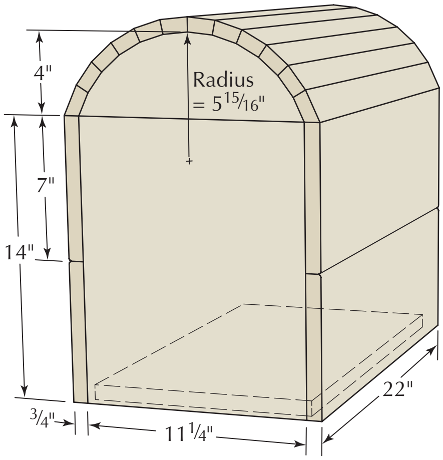
I painted my piece dark brown, then beat the heck out of it using a bunch of keys and a hammer. This process exposed raw wood in the "wounds," but I added a topcoat of dark Briwax paste wax to simulate years of dirt, working it in well to the newly exposed wood.

To age your hardware, you have a few options. You can soak everything in vinegar to remove the bright coating, or simply paint it black. Or, grab a propane torch and burn the finish off (make sure you do this in a well-ventilated area, and have a bucket of water on hand for quenching).

Attach the hardware, then wrap the belts around the chest, buckle them, drive in a bunch of upholstery nails to effect a studded look (I used them every $1^1/_2$" across the top, and every 2" on the front and back). If your belt is less than 60" long, you'll have to cut it and attach it at the top and bottom edge – I suggest long staples for this, covered with a upholstery nail.

Now load your chest with booty and start talking like a pirate. **PWM**

Megan is managing editor of the magazine. She wonders what it is about pirates that every kid of her acquaintance seems to adore.



3-D VIEW

Pirate Chest

	NO.	ITEM	DIMENSIONS (INCHES) T	W	L	MATERIAL
☐	4	Front/back planks	$^3/_4$	7	22	Pine
☐	2	Case sides	$^3/_4$	$11^1/_4$	14	Pine
☐	1	Bottom	$^3/_4$	$11^1/_4$	$20^1/_2$	Pine
☐	2	Top sides	$^3/_4$	$11^1/_4$	4	Pine
☐	12	Top slats	$^3/_4$	$1^1/_2$	22	Pine

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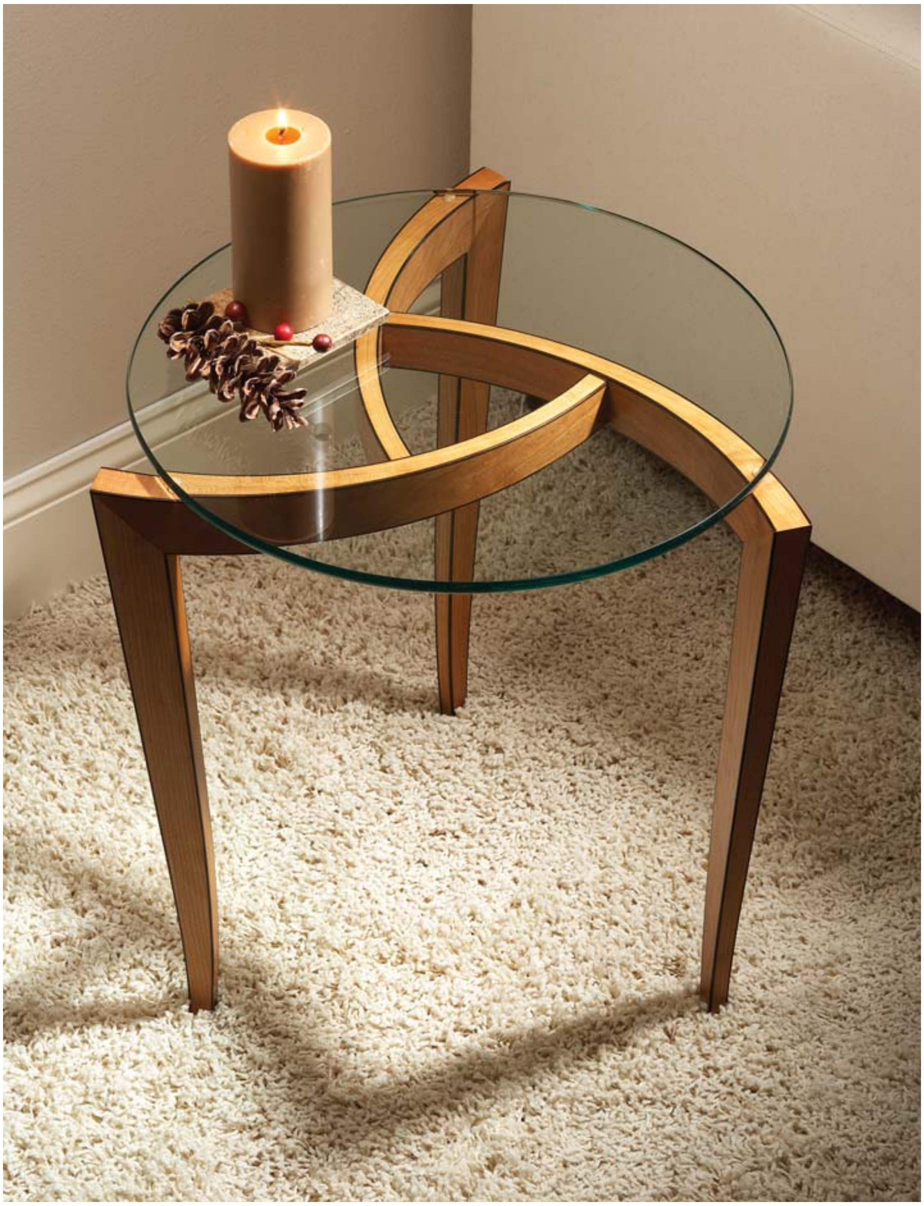
Three-legged Occasional Table

BY MICHAEL FORTUNE

Steam-bending or bent laminations can be used to make this eye-catching design.



Tripartite occasion. *This three-legged occasional table can be made with steam-bent hardwood or from bent laminations. This example is of steam-bent cherry with ebony inlay.*

The design of this table is part of a series that I revisit from time to time. The original concept for the series was based on a pinwheel (a common example of which is a child's pinwheel on a stick that blows in the wind.) This shape lends itself to repeating one design element several times then attaching them together, an efficient approach when making furniture. So far I've made several different stools, cabinets and even massive boardroom tables based on the same pinwheel motif. Generally speaking, I come up with an idea then problem-solve how to do it, often relying on the well-documented history of furniture making in books and magazines.

For this table I revisited a sketchbook that is 25 years old. At the time I had completed a commission for stacking tables with Australian lacewood tops and steam-bent cherry frames. In my design exploration there were several sketches that I thought had some value but didn't work for that particular commission so so I filed them away for use at a later date. My old sketchbooks have become an idea bank that I'll make a withdrawal from when I'm casting about for something to make.

To start this table I did a few more sketches then drew a full-size plan view that gave me the radius for the curve. From this I made a rough full-size mock-up of the table, the curves were simply band sawn from spruce 2x4s then glued and air nailed together. After holding up a leg at various angles, I expeditiously hand cut the miter joint where the curves met the legs.

With the basic idea confirmed, I made a bending form that would accommodate both laminating and steam-bending techniques. This way, I could use either exotic or domestic species. Here I've made the table in air-dried cherry that has been steam-bent. If the table were to be made in an exotic wood or if only kiln-dried

"Art is the desire of a man to express himself, to record the reactions of his personality to the world he lives in."

— Amy Lowell (1874-1925)
American poet

LEAD PHOTO BY AL PARRISH; STEP PHOTOS BY THE AUTHOR; ILLUSTRATIONS BY ROBERT W. LANG, FROM THE AUTHOR'S DRAWINGS

domestic wood were available, then laminating would be the appropriate choice. However, my preference is to steam-bend solid wood when possible so I can avoid cutting or shaping through the glue lines in a lamination.

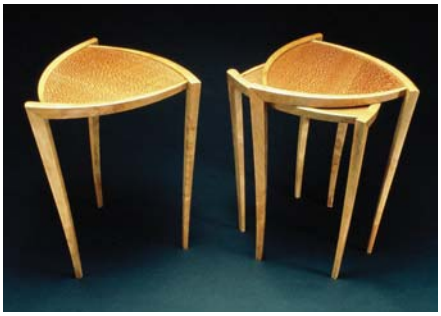
The Full-size Drawing

After my sketches, I always draw each project at full size. The drawings are often pretty basic, but it does get me thinking about the relationships of the various parts before cutting and possibly wasting wood. The drawing board is also basic. I put a piece of particleboard on sawhorses, lay out some cheap paper (bought on a roll) and use a drywall square to draw my lines. A beam compass or tension bows will draw the arcs. Any part I'm making can be laid right on the drawing to confirm the shape.

I've been woodworking for 35 years and have a full-size drawing rolled and stored alphabetically for every project. This step is very important in my design and construction sequence. Some projects are even built right over the top of the drawing. This drawing will help make the bending form, two cut-off jigs, the drill jig for the center joints and the center clamping cauls. (See the drawing on page 29.)

Making the Form

The drawing provided the dimensions of the particleboard form. The curved parts are $1\frac{7}{8}$" wide (side view) so I laminated the three pieces of particleboard together for a total of $2\frac{1}{4}$". The true radius for the arcs is 12", so I made the form with a radius of $11\frac{7}{8}$". The inside face of a lamination is smooth whereas the inside face of a steam-bent piece may not be. When I'm laminating I simply add a padding strip of $\frac{1}{8}$" hardboard to the form face. When steam-bending I can smooth out any imperfections along the inside and achieve the 12" radius.



Cherry, steambent curves. *Floating, right-angled plywood tenons join the legs to the top curves in these 20"-diameter x 20"-high stacking tables.*

Draw out the radius on the form and cut it freehand on the band saw if you can follow the line closely, or use a circle-cutting jig on the band saw.

Steam-bending

I've used air-dried cherry for this table. In addition to steam-bending well, air-dried domestic wood is much more pleasant to work with hand tools and generates less fine dust when planing by machine. It can also be less expensive. I pay about $2.50 per board foot for 8/4 stock (but it will be more expensive if it is not available in your area). The bending blanks are $1\frac{1}{4}$" x 2" x 18". If you are bending two at a time end to end, then the blank is 36" long.

The steam-bent curved parts on the table taper both in thickness, and in width along the 18" length, but I usually bend parts that are machined parallel, then cut the tapers afterward.

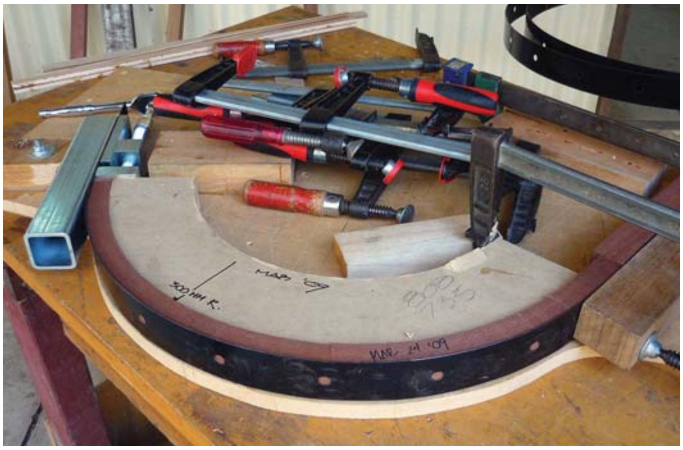
I use a Veritas 2"-wide compression strap. In a nutshell, wood that has been steamed then bent around a form will always fail along the outside face. The wood fibers stretch then separate. However, if the piece of wood is restrained with a strap and end stops (and thus restrained from stretching), then the inside face is put into compression. Steamed wood will compress a phenomenal amount before it fails.

In this case, the double blank was 36" long when steamed. After bending, the outside dimension remained the same while the inside was compressed to $32\frac{1}{2}$". The adjustable Veritas end-stop assembly makes it easy to remove the compressed blank. The bent parts are transferred over to drying jigs and left to set for at least five days (seven is better).

When bent properly, the bent part has no memory of being anything other than its new shape.

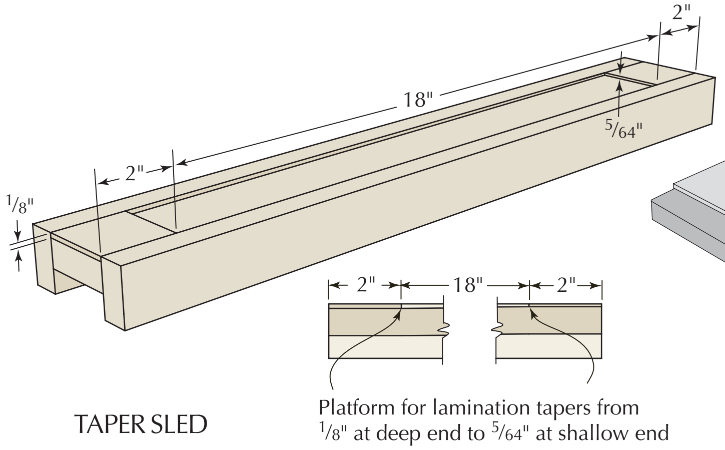
Or Laminating

The three identical curves on the top can be laminated. I always use a fixed male form with a flexible female form. This approach makes clamping tapers much easier.

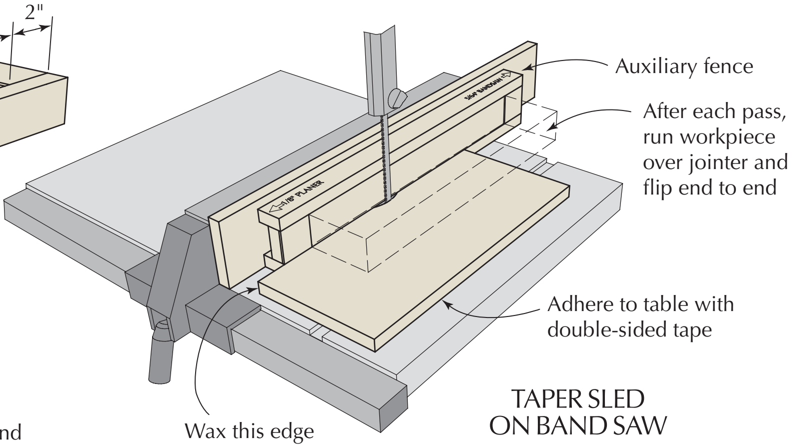


Compression strap. *The end stops bolted to this Veritas compression strap stop the wood from stretching and failing. The inside face must be put into compression for successful steam bending.*

Two parts at one time. *The parts are removed from the bending form after sitting for 10 minutes and are restrained with a wooden tie bar. They will acclimate to the curve in about seven days. Here are various air-dried woods that have been steam-bent.*


2"
18"
5/64"
2"
1/8"
2"
18"
2"
Platform for lamination tapers from 1/8" at deep end to 5/64" at shallow end

TAPER SLED


Auxiliary fence
After each pass, run workpiece over jointer and flip end to end
Adhere to table with double-sided tape
Wax this edge

TAPER SLED ON BAND SAW

Taper sled. *To make the sled, first machine the three boards straight and square. The center board is carefully glued and nailed in place at a slope between the two outer sled boards (remove the nails after the glue dries). The slope is determined by the desired taper. This sled should be 2" longer on either end than the length of the laminations. In the 2" space at the ends, glue in end stops that will restrain your lamination as you saw it or run it through the planer.*

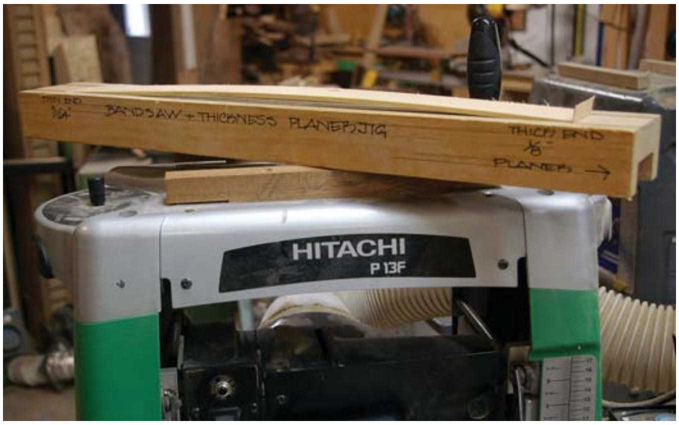
Taper sled in use. *The guide platform supports the board as it is cut into tapered laminations and keeps the sled tight to the band saw's fence as the sled slides back and forth. The guide platform should be the same thickness as the runners in the sled (usually 3/4" thick). Press your blank into the notch in the sled and push everything forward into the blade. After cutting one lamination, joint off the blade marks on the blank, flip the board over (end over end), and repeat the cutting sequence. After cutting all the laminations, each is placed back into the sled and passed through the thickness planer after a shim has been glued to one of the end stops.*

For this application it is best to make tapered laminations so that when the outside curve is cut it doesn't run obliquely through the glue and laminations. This would compromise the finish in the completed table. I use a jig on the band saw (see drawing above) to cut the tapered laminations. There are nine laminations on each bent part. The thick end is 1/8", totalling 1 1/8", while the thin end is 5/64", totalling 45/64", or just over 11/16".

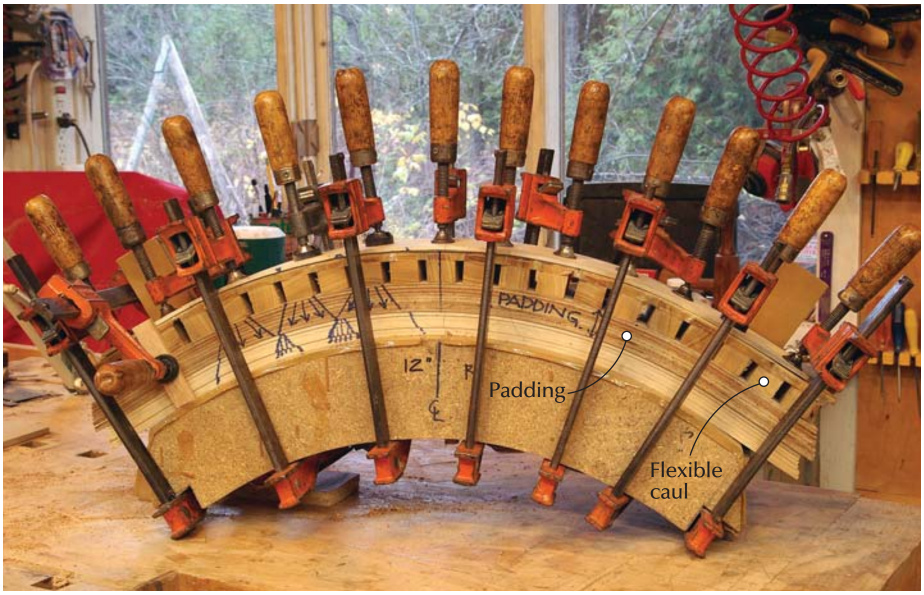
The block of wood that yields the laminations is marked with a triangle so it's easy to reassemble the laminations the way they came off the board. Start with two boards 2" x 4" x 18" long. They have to be machined to the same dimensions so they'll fit in the jig. Rift-sawn grain is best because it disguises the glue lines and both the top and side surfaces have the same grain configuration.

After each lamination has been band sawn, the boards are jointed and flipped end for end. This way the edges of the board remain parallel throughout the process of cutting the tapered laminations. You'll get two stacks of laminations from each board, with the grain match missing by a lamination. If you forget to flip the board you'll run out of wood on one end due to tapering.

After all the laminations are band sawn (all are band sawn on one face, jointed on the other face) the laminations can be passed through the planer on the same jig.



Band saw & planer jig. *The shim makes the tapered lamination bow up about 1/8". It is tack-glued to an end stop and flushed off with a knife. When the infeed rollers press the lamination flat it is wedged tight against the end stops. This avoids the laminations getting picked up and shredded by the planer.*



Particleboard lamination form. *About 1" of padding strips (hardboard) and a flexible caul (with the stapled cross blocks) spread out the clamping pressure so the glue lines are perfectly consistent. Start clamping at the thick end and alternate the clamps, working toward the ends.*

A Process in Design

I started with very rough sketches on tracing paper. I looked on the web for glass tops and found an 18"-diameter $\frac{3}{8}$"-thick tempered glass top that was about the size I had in mind for this table. I thought the shape of the table should dominate the glass so I let the legs stick out farther than the diameter of the glass.

I made a full-size mock-up from the rough sketches to prove the concept in three dimensions, then used information from the sketches and the mock-up to generate an accurate full size drawing. The full-size drawing provides all the information needed to build the table precisely.

I started the full-size drawing with the diameter of the glass. I divided the circle in three parts by stepping off divisions around the circumference with the beam compass used to draw the circle. This makes six segments around the circle. I drew a line from the center to every other mark to define the three divisions.

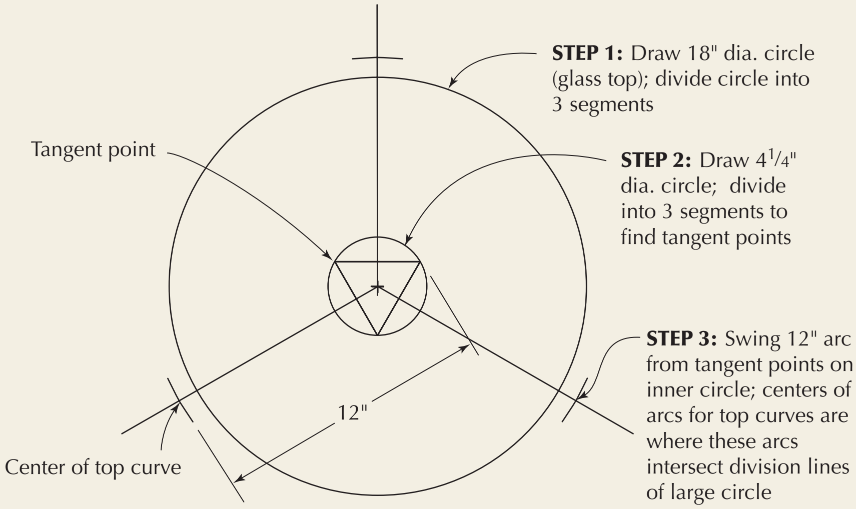
The next decision to make was the size of the triangular center shape. I roughed in a few different-sized circles and swung different-sized arcs tangent to the circles. My full-size mock-up told me that the three curves, with a radius of 12", should be tangent to a $4\frac{1}{4}$" diameter circle.

I drew the $4\frac{1}{4}$" circle and divided it into three segments, opposite the divisions in the large circle, to locate the tangent points. I swung 12" radius arcs from these points to intersect with the lines dividing the large circle to locate the center points for the arc of the inside curve of the top rails. The outer curve of the rails is offset from the inner curve by a different dimension on each end: $\frac{11}{16}$" where the curves intersect each other in the center, to $1\frac{1}{8}$" where the rails meet the legs, beyond the edge of the glass.

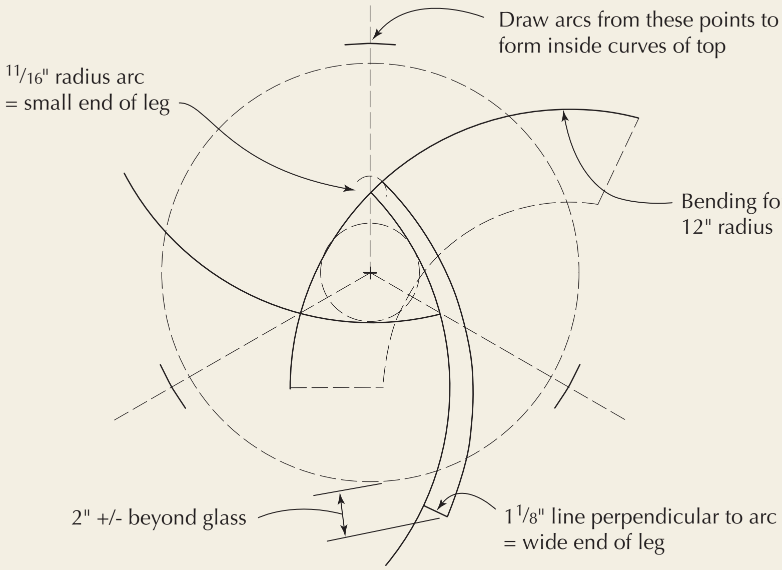
I picked the length of the curves where they overhung the glass by blackening out the ends of the lines with electrical tape until the size looked pleasing to me.

With the design decisions made, I darkened in the curved lines and radius points I was going to use in construction. The bending form and all of the joinery jigs relate to the arcs and radius points so there is no guesswork. Because I had a full-size drawing, I could confirm all my shapes by comparing them to the drawing as I worked.

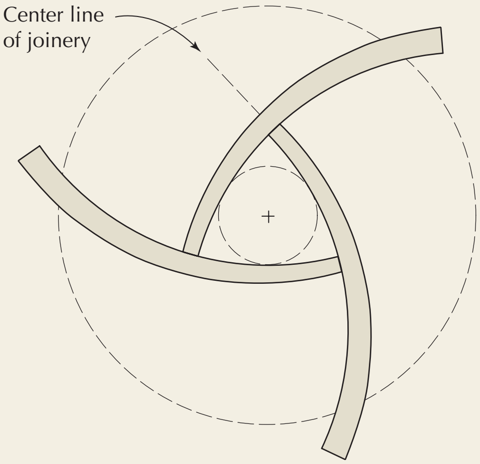
The drawing became the repository for all of my sketches as I figured out how to build the bending form, the jigs to cut the joints, and the cauls used to clamp the parts together during final assembly. The drawing is more than documentation; it is a valuable tool that is essential to have during the building process. —MF



STEP 1: Draw 18" dia. circle (glass top); divide circle into 3 segments
Tangent point
STEP 2: Draw $4\frac{1}{4}$" dia. circle; divide into 3 segments to find tangent points
STEP 3: Swing 12" arc from tangent points on inner circle; centers of arcs for top curves are where these arcs intersect division lines of large circle
12"
Center of top curve



Draw arcs from these points to form inside curves of top
$\frac{11}{16}$" radius arc = small end of leg
Bending form 12" radius
2" +/- beyond glass
$1\frac{1}{8}$" line perpendicular to arc = wide end of leg



Occasional Table

	NO.	ITEM	DIMENSIONS (INCHES) T	W	L	MATERIAL	COMMENTS
☐	3	Legs	$1\frac{3}{16}$	2	20	Cherry	Blank size
☐	3	Top rails	$1\frac{1}{8}$	2	18	Cherry	Finished size

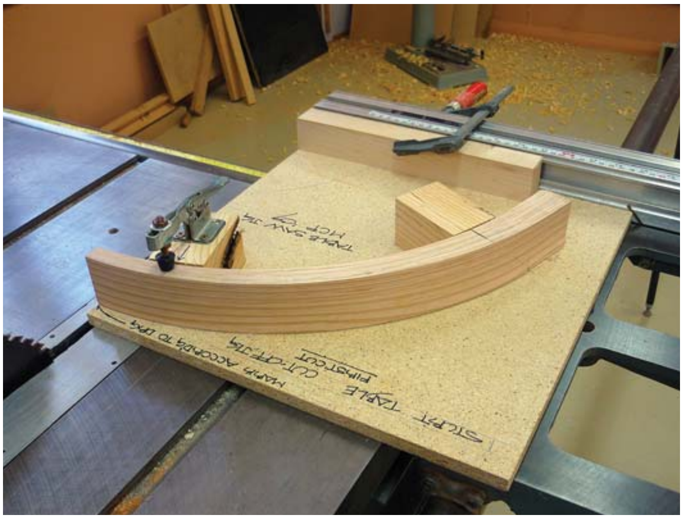
A wonderful trick here is to tack-glue a slip of veneer to one end stop on the taper jig. The laminations will now fit only between the stops if they are bowed up slightly, about 1/8". As they are passed though the planer (thick end first) the infeed and outfeed rollers press the bowed laminations down and snug between the stops. This will eliminate shredding laminations in the planer.

To spread out the clamping pressure I always add about 1" of padding strips to the lamination. These are either extra laminations or strips of 1/8" hardboard. This spreads out the clamping pressure and ensures even glue lines. I start clamping on the thick end and progress down the length, alternating the bars on either side.

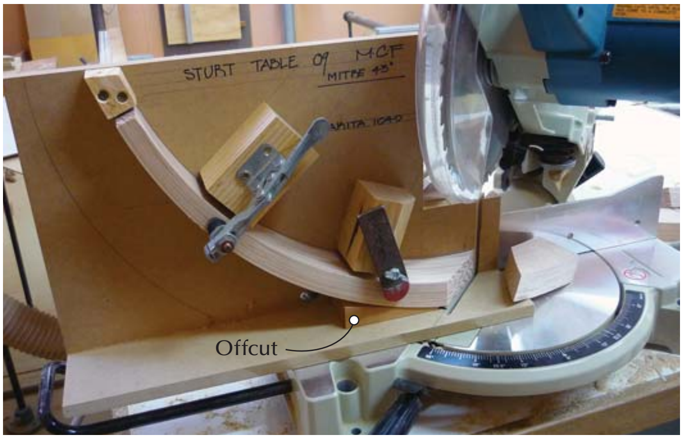
For exotic woods I'll use a slow-set epoxy; my choice here is System3, G2. For medium- or dark-colored domestic woods I'll use Franklin Titebond III. On light woods I'll use a high solids white PVA such as Franklin Titebond II. Adding at the very most 5 percent of cornstarch to the PVA will make it more rigid.

I spread the glue with a notched metal spreader (see Supplies). This spreader deposits the perfect amount of glue – too much would make a wasteful mess; too little would yield dry joints. With domestic woods, glue has to be applied to only one side of each lamination. Exotic woods should have both sides coated.

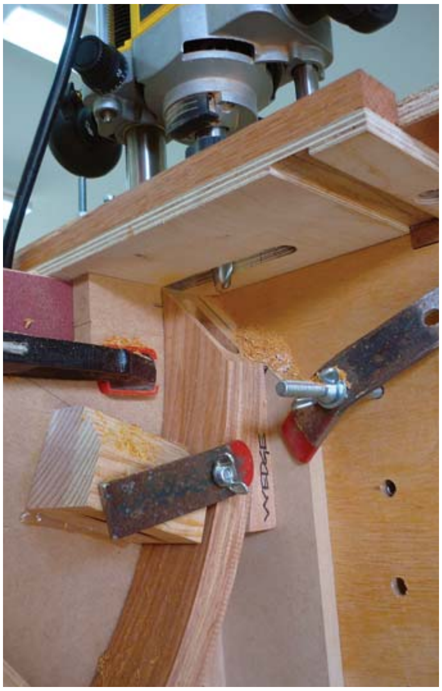
Whether laminating or steam-bending,



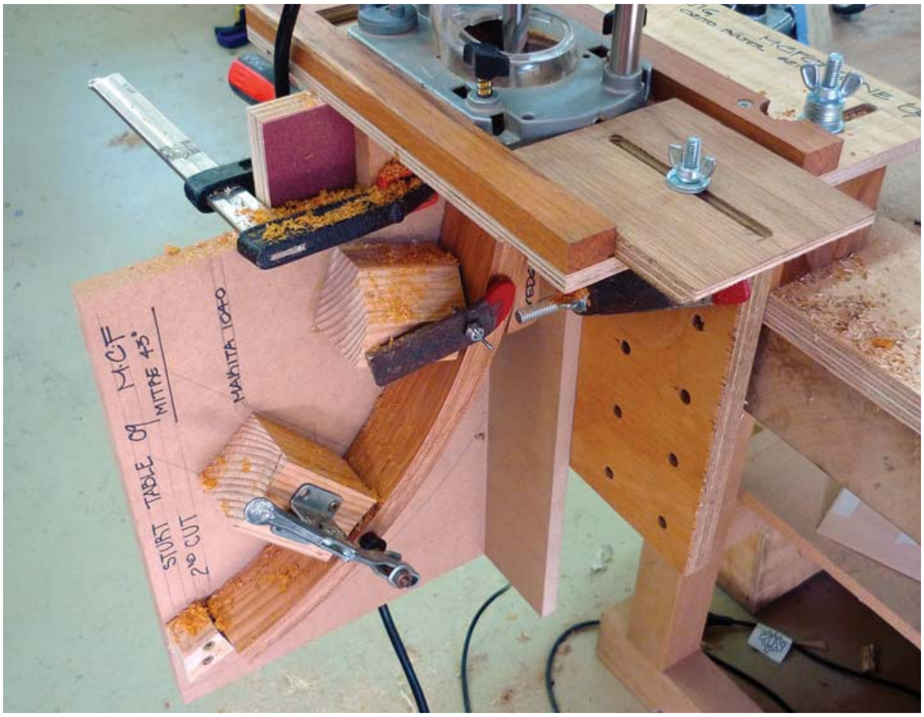
Cut-off jig. *This table saw cut-off jig ensures the small end is cut square to the curve where it intersects a second rail.*



Mitered curve. *The position of the curve is drawn on a piece of particleboard. It has been duplicated from the full-size drawing. The thin end offcut from the table saw is placed against the stop. The miter saw is set for 43°. A hold-down is necessary close to the miter cut. Coarse sandpaper is glued to the jig so the part is not pulled out of position as the cut is made.*



Bottom up. *Here is an underside view of the shop-made mortising jig with the miter saw cut-off jig and curved part clamped in place.*



Two jigs in tandem. *The miter saw jig is clamped to the shop-made mortising jig. A plunge router slides in a track and bores the mortise in the mitered face of the curved parts.*

the three curved parts should be jointed then planed to $1\frac{7}{8}$" wide.

Cutting the Joints

I recommend making a table saw jig to cut the three parts to length. The length can be marked on one of the pieces right from the drawing as can the configuration of the table saw jig to hold them.

The curved rails taper in width, so the inlays on the joined edges at the center of the table don't meet (the glass rests on the outer edges of the rails). Cut the thin end off first. This cut becomes the reference for the miter cut that is done on a miter saw.

Clean mortises. *A two-flute aluminum cutting end mill, when mounted in a plunge router, cuts a clean mortise. These bits are inexpensive (approximately $12) and are available from machine tool supply companies. Avoid three- and four-flute bits – they don't like to plunge cut.*

The miter joint has to be strong so I've chosen to use a right-angled floating tenon. The curve and the corresponding leg at each joint have deep-bored mortises cut into the end grain. A right-angle Baltic birch plywood tenon – that not only bridges the joint but penetrates both members – is inserted.

The rough mock-up suggested that the angle between the top curve and the leg should be about 86°, so the jig to hold the part on the miter saw will cut the thick end of the curve at 43°. Again, the drawing comes into play here. The radius point on the miter saw jig is identified so the cut is square to the curve. The jig should be securely mounted on the miter saw. I drilled and tapped the miter saw fence years ago for this purpose. Hold-downs should be installed and coarse sandpaper glued to the jig face so the part is held firmly during the miter cut.

Once the miter cuts have been made, the jig can be moved over to your mortise jig. I made this jig from Baltic birch plywood and I use it when I'm teaching in locations that do not have a mortise machine. I have used this jig for many years and recommend it as an inexpensive and effective means of cutting mortises.

The mortise bits I use are actually used for milling aluminum. They are described as two-flute aluminum cutting end mills. These bits are very inexpensive and come in a wide variety of sizes. For this operation I am using a $\frac{3}{8}$"-diameter x 4"-long high speed steel bit. The shank is $\frac{3}{8}$" diameter, an adapter sleeve can be purchased from Woodcraft to make it fit a $\frac{1}{2}$" collet plunge router. Light passes are best, plunging in only $\frac{1}{8}$" each time. A cautionary note, only the two flute bits will plunge, the three- and four-flute bits will not plunge.

Supplies

Lee Valley Tools
leevalley.com or 800-871-8158

- 1 ▸ strap clamp, 2" material #05F11.01, $89.50
- 1 ▸ Waxilit #56Z99.61, $15.95

Hyde Co.
hydestore.com or 888-211-8621

- 1 ▸ notched adhesive spreader #19120, $1.20

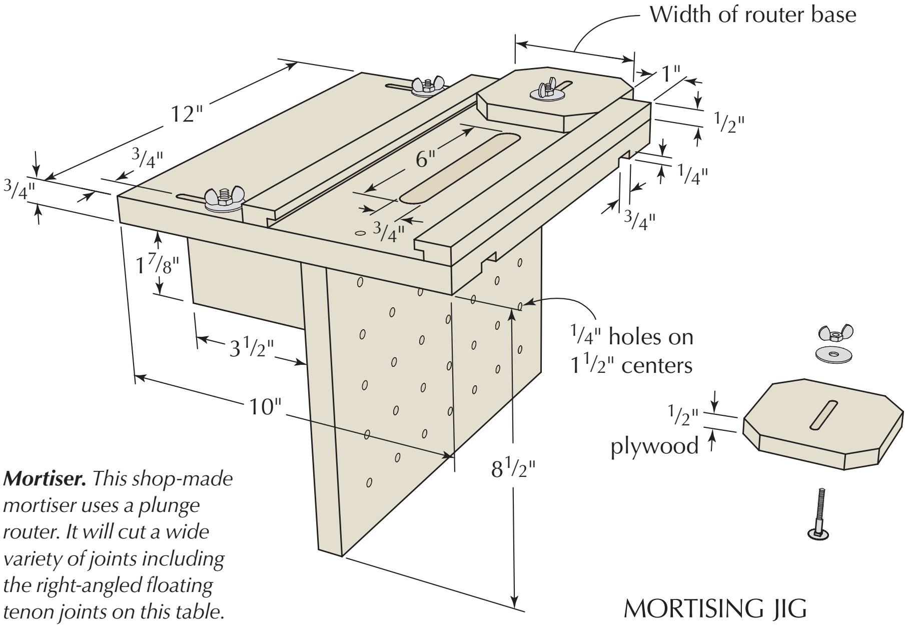
Glasstopsdirect.com
glasstopsdirect.com or 800-850-6467

- 1 ▸ 18"-dia. $\frac{3}{8}$"-thick tempered glass top, pencil edge, $30

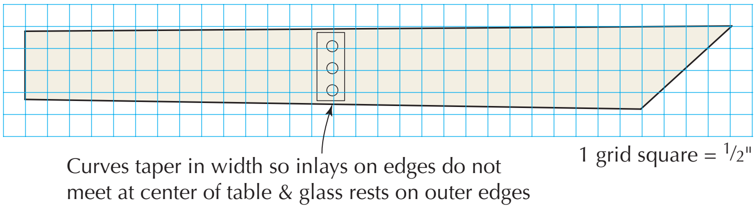
Prices correct at time of publication.

Because the mortise is cut into the end of the curve, the mortise should be placed closer to the inside curve – otherwise it may penetrate the outside curve. The depth of the mortise is $2\frac{1}{4}$".

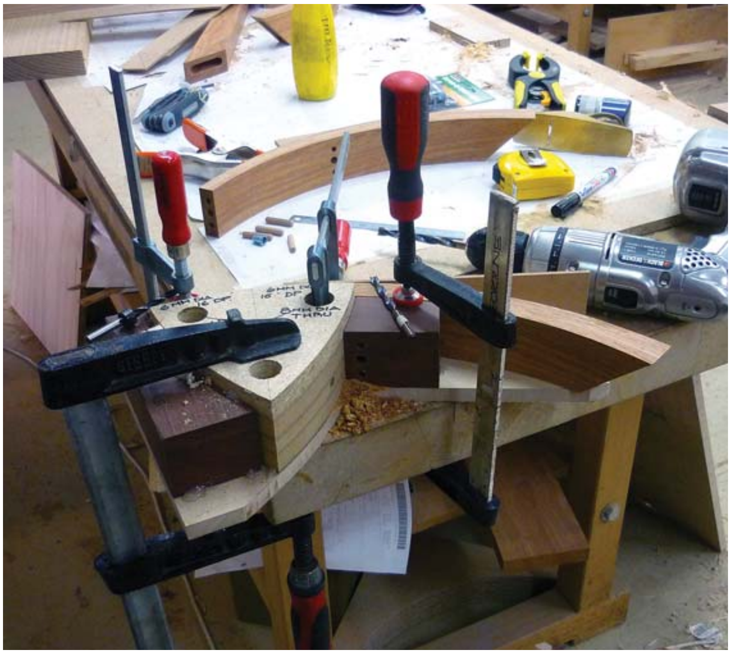
The triple dowel joint on the thin end of the curves can be done now. The negative space created where the three curves come together becomes a mandrel to hold the parts during the boring operation. The drill guides made from blocks of wood are drilled on the drill press so the holes are tangent to the curve. Choose a hard resinous wood for your drill guides. The holes in the side of each curve and in the end grain are made with a hand drill through the block to keep the drill square. If care is taken, this type of drill jig will last for many years. Keep the dowels closer to the middle of the joint; this will allow the curved part to taper so it doesn't sit flush at the intersection. I've made some of these tables to be assembled by the purchaser, so the middle hole is actually a metal fitting while the two outside holes are dry dowel joints.



Mortiser. *This shop-made mortiser uses a plunge router. It will cut a wide variety of joints including the right-angled floating tenon joints on this table.*

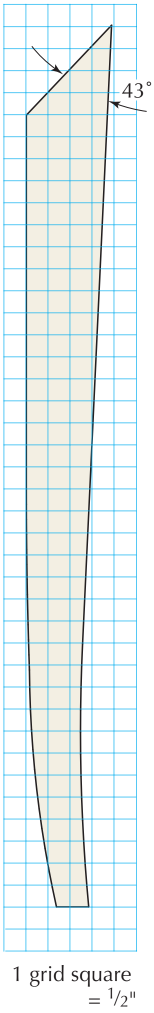

Curves taper in width so inlays on edges do not meet at center of table & glass rests on outer edges
1 grid square = $\frac{1}{2}$"

RAIL PATTERN



Center space. *The center triangle shape is the center space between the curves. The curved parts are clamped to this shape. The blocks of hardwood are drill jigs. These holes were drilled on a drill press. The actual dowel holes are bored in the parts with a hand drill. The dowel holes are bored going in opposite directions through the same hole – this way the dowel holes always line up.*

I used metric drills for this variation of the table because I constructed it in Australia where the metric system is widely used. This one jig drills the side dowel holes as well as the matching end dowel holes.



LEG PATTERN

The leg blanks can be made next. This small side table is about 20" tall, the width of the leg blank is $1\frac{7}{8}$" and the thickness is $1\frac{3}{16}$". The extra thickness on the leg will allow for some hand fitting when the legs are joined to the top curves. Once the miter joint is cut and the mortise is deep bored, then the part can be band sawn to shape and tapered in thickness so the footprint at the floor is about $\frac{5}{8}$" square.

Dry-fit the miter joint and scribe the shape of the miter curve onto the miter face of the leg. The surface of the leg is actually concave on the inside and convex on the outside. I use a stiff card scraper shaped to the concave face and a block plane to create the convex face on each leg.

Insetting the Ebony

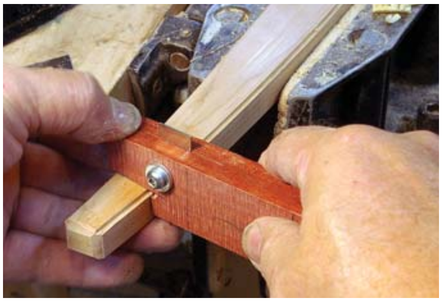
Once all the miter joints have been flushed, the three assemblies are ready for the inlaid ebony. This is a two-stage process. The inside edges are done first. This way it is easier to get a perfect match where the ebony intersects. After the joints have been glued the outside two edges are done. It is easier to line up two ebony edges rather than four at once.

I thickness plane ebony strips to $\frac{3}{32}$". Each strip is about 1" wide and 20" long. I use a small benchtop planer with a fixed sled. I slowly rip the strips to $\frac{3}{32}$" on the band saw with a piece of hardboard underneath for zero clearance. This gives me lots of $\frac{3}{32}$" square ebony inlay.

I use a rabbet bit on the router table

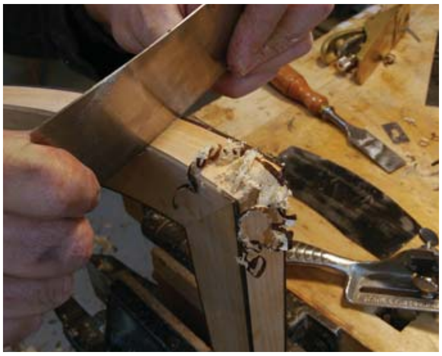
Taper. *The taper is cut along the outside of the three legs.*

Scrape. *The inside face of the leg, all the way to the floor, is card scraped to a concave surface to match the apron curve.*

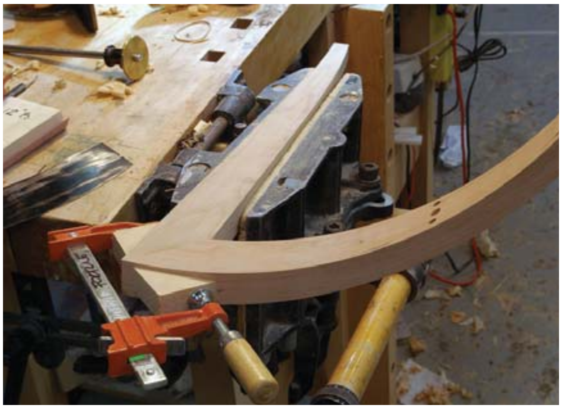


Shop-made rabbetting tool. *Some of the edges aren't square where they intersect concave and convex surfaces. I've mounted small pieces of tool steel in hardwood blocks that mimic the angle at these edges to form the rabbets.*

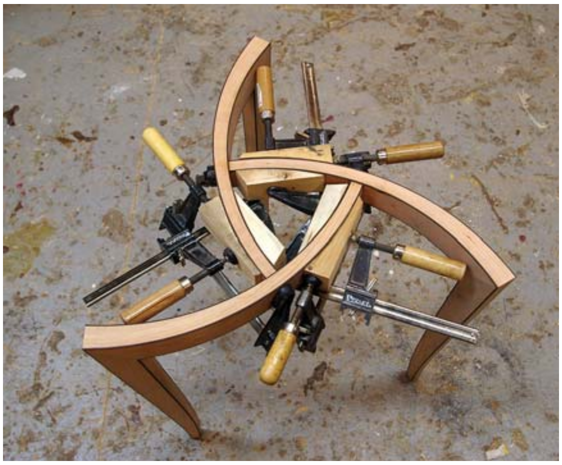
Inside, then out. *The inside corners are done first.*



Don't sand. *Use a card scraper to flush the ebony. Avoid sanding, as the dust would contaminate the surrounding light wood.*



Curve transfer. *The concave curve of the apron is transferred over to the leg.*



Cauls. *Clamping cauls faced with #100-grit sandpaper are clamped to the curves. The clamping pressure must always be perpendicular to the glue line.*

I determined the shape of the cauls and direction of the clamping pressure from my full-size drawing.

to take some of the waste away then finish the rabbet with Stanley No. 66 beader and a shop-made beading tool that I've fitted with a square piece of hard steel. The ebony strips are hand sanded with a hard block to remove any oxidation immediately before gluing in place. This provides fresh unoxidized glue faces. Slow set cyanoacrylate glue is laid in the rabbet and the ebony is clamped in place with tape and elastic bands. Accelerator is sprayed on a Q-tip and run along the joint. The ebony is flushed off with a card scraper. Avoid sanding; the dust will be pushed into the surrounding lighter colored wood.

Assembling the Miters

I am very particular when gluing projects together. Something that went together well in a dry-fit may not be so cooperative when the glue is applied. When I am clamping curves or angles I always use glue blocks that give perfect perpendicular pressure across the glue line. In this case I'll use pine cauls that have been glued with PVA right to the surface so the caul doesn't slip when the clamp across the joint is tightened. The pine triangles are easy to remove. Use Titebond III for domestic woods and epoxy for exotic woods (or if your joinery has a gap or two).

Assembling the Dowel Joints

Perpendicular clamping pressure is key here. All three dowel joints have to be assembled at the same time. I made custom cauls faced with #100-grit sandpaper for that purpose. Cleaning the inside corners can be difficult so I dry-fit the joint then sparingly use Waxilit around the joint. The glue is applied and left to squeeze out onto the Waxilit. The hardened glue is easily removed. The Waxilit residue is removed with denatured alcohol and a toothbrush. I've been using Waxilit for 15 years and have never had it detrimentally affect a finish.

One final detail: Chamfer the feet about $^{1}/_{8}$" all around so the wood doesn't splinter when the table is dragged across the floor. This table base has a satin lacquer finish, but an oil finish is OK, too. The top is $^{3}/_{8}$" tempered glass with a polished pencil edge; it sits on three sticky back plastic "fish eyes" meant to hold glass tops in place. **PWM**

Michael is an internationally recognized furniture designer and builder, and a woodworking instructor. He lives and works in Lakefield, Ontario.

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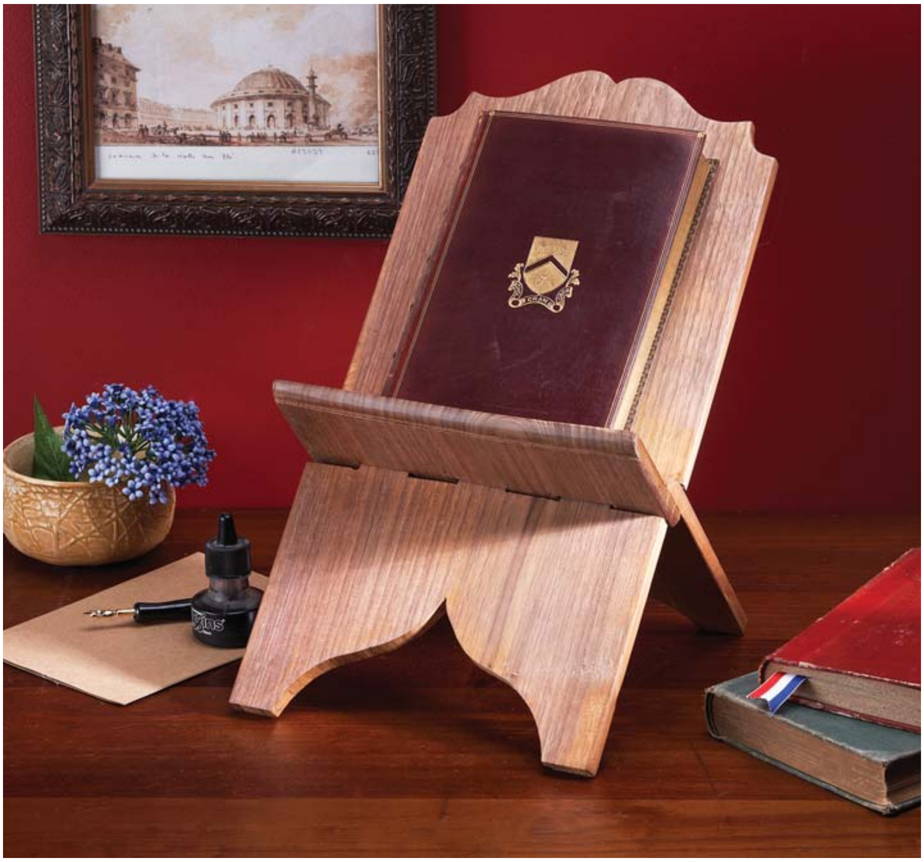
Roubo's Folding Bookstand

BY ROY UNDERHILL

A woodwright translates (and channels) the 18th-century French Master.



One-piece woodworking. *Roubo's bookstand supports a life lived with books. Framed on the wall is Roubo's timber dome over the Paris wheat exchange – Thomas Jefferson's favorite spot for a romantic rendezvous.*

Translating André Roubo's instructions from the 18th-century French is a delight, for he speaks to you as if he's just stopped by your bench. The level of detail assures you that this is something he has done himself, and the money-saving tips remind you of his early days as a poor apprentice. Even the way he often leaves out the first thing you should know until the very last gives you the sense of a mind overflowing with knowledge.

This little bookstand from plate No. 331 of "L'Art du Menuisier" will give you a quick dip into the torrent of his genius. It's a modest but appropriate introduction to the man, because books truly bookended his life story – as we'll see when we first walk a few miles in the boots of Monsieur Roubo.

Paris, July 14, 1790

Church bells began ringing through the rain at 5 a.m., but everyone in Paris had been awake for hours – if they had slept at all. André Roubo's boots were soaked through by the time he reached the door to his workshop. He fished the key from the sodden pocket of his blue lieutenant's uniform, unlocked the door and half-closed it behind him. Once inside, he slumped into a sigh that was instantly followed by uncontrollable coughing. Gagging for the moment, he pushed forward into the blackness of the shop and slapped his hands onto the first of the eight long workbenches.

Roubo rested there for a moment, drawing strength from the massive oak benchtop. Slowly, running his hand along the dips and damages of the front edge of the top, he eased down its length until the nip of the iron-toothed bench dog told him he was at the end. Reaching out with his left hand through the darkness, he rattled against the chisels lined up in the rack on the rear of the neighboring bench. Reassured, he turned and made his way slowly back toward the door. Dawn was approaching and so too was his duty for this momentous day. Outside, joyous in spite of the persistent showers, singing packs of torch-bearing, arms-over-each-other's-shoulders citizens passed the half-open door. The beloved Benjamin Franklin had inspired their song. When asked about the rocky progress of the American revolution, Franklin always replied, "It'll be fine, be fine!" And so the citizens sang the new song as they passed, "It'll be fine, be fine!" – everyone relieved that their own revolution seemed to have been won so quickly with such minimal violence – at the cost of only a half-dozen heads to speak of. "It'll be fine, be fine!"

"The torch of theory must illuminate the lessons of experience."

— André Roubo (1739-1791)
"L'Art du Menuisier"

Much Like Franklin

Roubo watched as the torches passing in the street sent flickering beams sweeping across the vacant workbenches. No crowds would ever sing words from his books. "The torch of theory must illumi-

LEAD PHOTO BY AL PARRISH; STEP PHOTOS BY THE AUTHOR

nate the lessons of experience," was simply not as catchy as "It'll be fine!" Still, he had much in common with Franklin. Like him, Roubo had once been a penniless apprentice who had often chosen to buy books over having a full stomach. Young André had even made a habit of pocketing candle stubs so that he could work through the night, studying his old books.

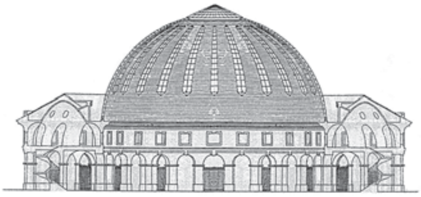
But there were no candles now – not in the shop and pitiful few at home. The fear and chaos that followed last year's destruction of the Bastille had also killed the high-end woodworking market. For the past year, if you couldn't eat it or sew it into the seams of a corset for an escape across the channel – nobody wanted it. With no work coming in and no money to pay the men, Roubo had been relieved to let them go work across town on the preparations for today's grand celebration. But now the shop smelled dead without them; the glue pots had been cold for weeks. He shivered and stacked himself back onto his feet. He had a long way to walk.

Back in the dark streets there were now so many people that he had to join in an ad-hoc phalanx of fellow national guardsmen in order to progress at all. The surrounding crowd cheered at them, and this alerted the crowd ahead who made way for them to pass. Even when wind caught water vomiting from the gargoyles of Notre Dame and bucketed it over the sodden citizens, they cheered all the more.

Triumphant Dome

The 50,000 citizen-soldiers were to assemble for the great march in the streets northeast of Notre Dame. Roubo, however, pushed off to the left when they reached the market halls. As he neared the corner he tilted his head up into the rain so that his masterwork would come properly into view – and there it was! Lamps had been hoisted high in the great dome, and the 25 glass skylights glowed like fiery ribbons against the dawning sky. Lieutenant Roubo returned the salutes of the guards and threaded through the funk of wet and sweat to the very center of the 130'-diameter central dome. His company shouted greetings and fumbled to attention as they saw him. Their words were lost in the racket of the crowd, but their enthusiasm was clear enough.

Roubo had been celebrated in this building before – for the dome above them was his creation. In 1782, when the grain merchants of Paris finally admitted that they needed a roof for their doughnut-shaped trading hall, they had turned to him – and he had turned to his old books. In a long-forgotten treatise from the 1500s Roubo found the answer – or at least the theory – that a great dome could be built of laminated timbers.



Roubo's dome. *Jefferson copied this dome at Monticello. Without Roubo, the back of the American nickel would be blank!*

It took five months for his men to build the wooden spars and raise them into position. When the day of reckoning finally arrived, the workmen chose to pull out the props by tugging on ropes from a safe distance. Roubo, however, stood confidently under the great timber dome, just where he stood now, watching, listening, as the load eased onto the precisely scarfed pine ribs. When the last prop fell away and his great dome of theory settled to become a triumph of woodworking practice, the breathless hush lasted but a heartbeat before it was broken by the whoops and hollers of the workmen. They rushed in and hoisted him on their shoulders and carried him about in triumph. Those evenings with the old books and scavenged candles had paid off.

The dome made him famous – for even those who were not inclined to buy his great four-volume treatise on the art of woodworking could stand beneath this dome and recognize the work of genius. The stunning dome quickly became the preferred place of rendezvous. All Paris knew that the widowed American minister to France, Thomas Jefferson, had been meeting his (married!) lady love under this great span. It was even said that, when they parted, he returned to Virginia determined to rip the roof off his original Monticello and rebuild it with a great dome in memory of her.

But now it was time for them to leave the sheltering dome as well. The men assembled behind Roubo, and they eased into the snail's progress through the streets. Flowers tossed from the windows above, unless they were caught in midair, fell into black puddles churned by a hundred thousand footfalls.

July 14, 1790. *Roubo's bookstand holds the Bible as Lafayette swears allegiance. Within months, France fell back into bloody civil war.*

Altar of the Nation

Slowly they crossed the Seine on a bridge made of lashed-together boats. It took hours, but the roar of the 400,000 spectators waiting for them in the great earth-banked stadium continued undiminished. Roubo's company finally took its place in the muddy field near to the raised "altar of the nation." At the end of the stadium he could see that the viewing stand atop the huge timber-built, triple triumphant arch was dangerously overloaded with spectators. This is where his men had been working, and he hoped they had done their job well.

Suddenly Roubo was sweating. Where he had been shivering before, now he was burning up! He turned about to see if his assembled company felt the sudden heat, but they stood cool. The sight of them took his mind off the fever. Among these citizen-soldiers were some of the craftsmen he had consulted as he compiled his great books – works so comprehensive on every aspect of joinery and cabinetmaking that no one man could have professionally practiced all that they covered. He had written the books for them, his fellow craftsmen, and he had fought for them as well, trying to preserve the high standards of the old guilds against the new

Planche 331, 'L'Art du Menuisier,' par André Jacob Roubo

This bookstand is solid wood, but peculiar in that although it hinges open, it is one and the same piece, without needing any kind of iron fitting.

Construction is, however, very simple. Start by planing a piece of wood the length & thickness suitable to contain the two pieces *A*, *B (Fig. 2 & 4)* and the gap between them, which should be the least possible, that is to say, just the kerf left by the saw, and a bit more so it can be planed smooth.

When the wood is well planed, we draw the hinge in the following way.

After determining the height of the foot of the stand, made below the hinge, draw on the side of the piece *(Fig. 5)* the height of the hinge, which must be equal to the thickness of two pieces taken together, as shown by the lines *i-l* & *m-n*. Draw this at a slight slope to prevent the stand from opening entirely square, as the shape of the hinge in the corner *(o, Fig. 2)* tends to push the book out and make it slide off.

When the height of the hinge is drawn, use the point *p* as the center to describe a circle which touches the lines *i-l* & *m-n* – less a bit to allow for the very thin chisel used to cut the circle shape of the hinge. We will cut this circle shape by referring back to the diameter drawn on these outside knuckles.

That being done, draw across the face, as in *Fig. 6*, the length of the hinges based on the lines *i-l* & *m-n*. Then divide the width into an odd number, observing that there is some play between the separation lines needed for the passage of a thin saw blade, with which we cut the space *q-r*, *Fig. 5*, which remains after the knuckles have been cut on both faces, as shown in *Fig. 6*.

After you have cut and carved the hinge, scroll cut the bottom of the foot, as, for example, *Fig. 3*. Then saw the two parts *A*, *B*, down their thickness, both above and below the hinge. When well executed, the two pieces will open on themselves.

When parts *A*, *B* are well separated, finish them with the plane. The bookstand may be painted & carved, as sometimes happens, or left in its natural color with a polish, as is usual.

It is, however, good to note that when there is to be decorative carving on the bookstands, it should be done before sawing the two pieces apart so that the hinge is not damaged or broken.

These desks are never made singly, but two at a time. This is to prevent the great waste of wood between *t & s, Fig. 4*. When we make two at a time, one overlapping the other, we must increase the length of the original plank by that of piece *A*, plus what it takes to get the saw in and started. In this method, you save nearly a foot of wood for two, which is well to consider, as these reading stands are made of beautiful walnut – or at least they should be.

— translated by RU

Fig. 1.

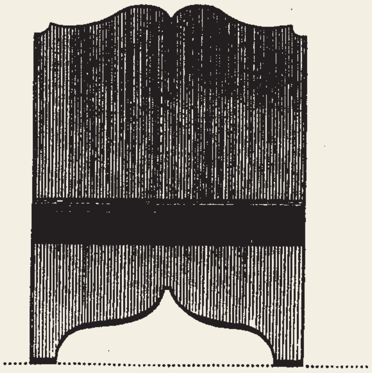


Fig. 2

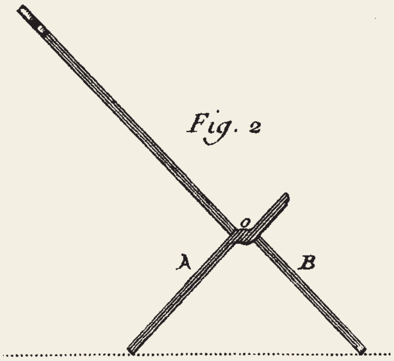


Fig. 5.

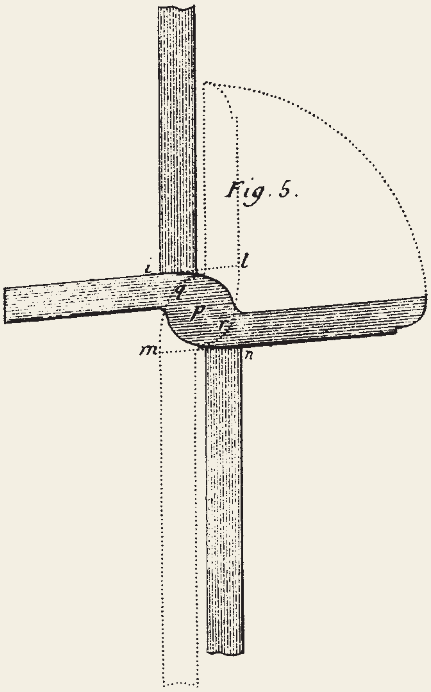


Fig. 3.

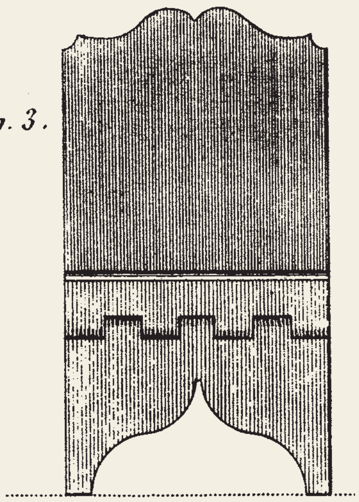


Fig. 4

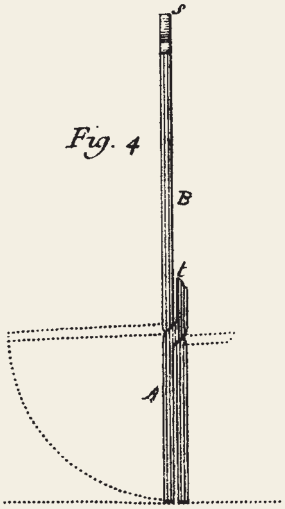
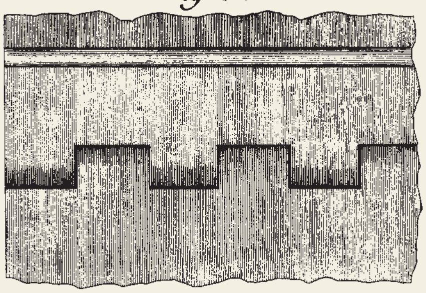
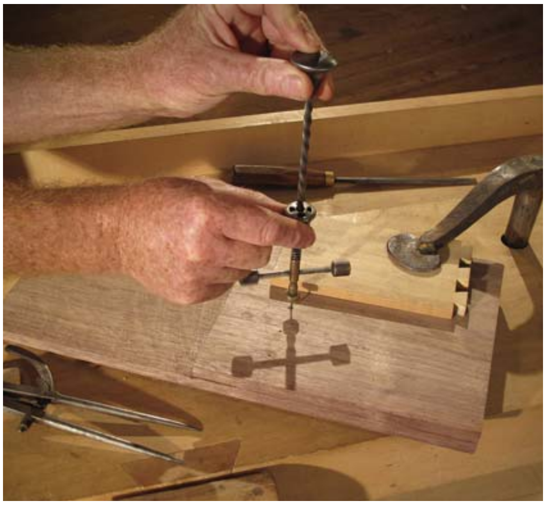
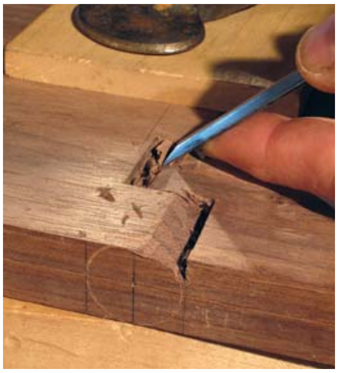


Fig. 6.

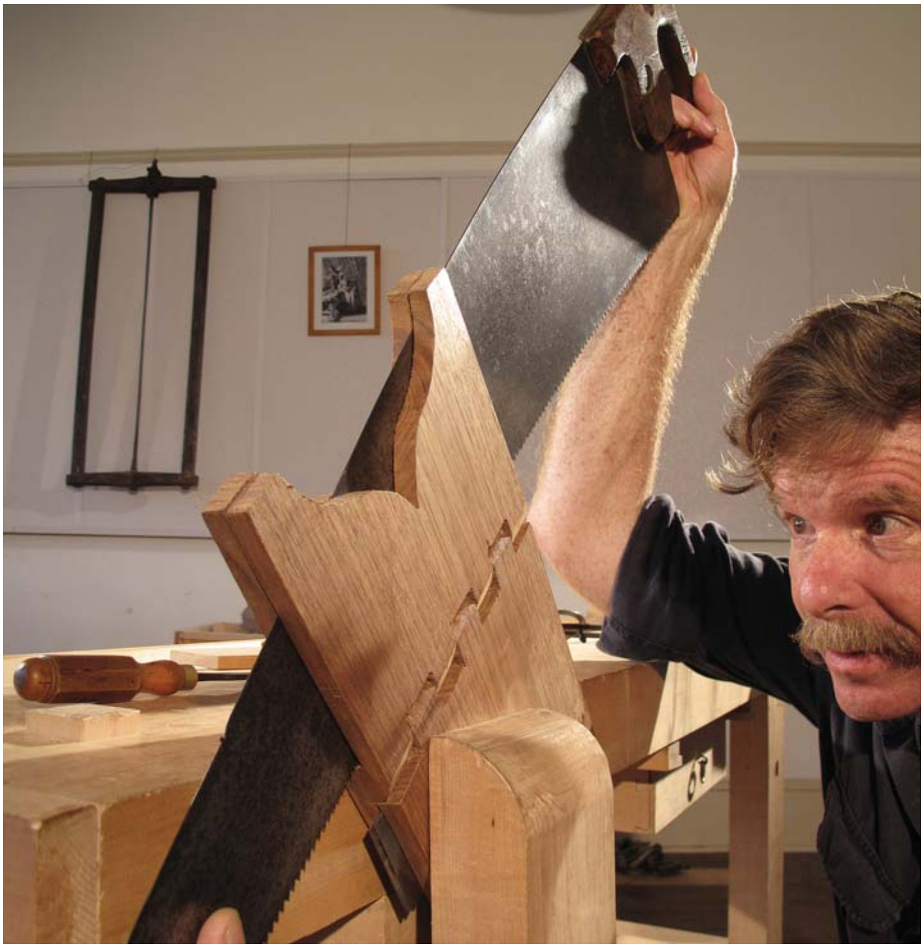




Drill first! *You'll probably want to drill a little hole between the hinge knuckles to get the coping saw blade started. If you drill the holes before you begin chiseling, you'll be absolutely sure that the knuckles are perfectly aligned down the front and back of the hinge. Hold off on the sawing, though, until the knuckle carving is complete – you'll have less wood to cut. This stand measures 1" x 8" x 16" with the hinge 6" up.*



Pare with care. *Start carving the hinge barrels with a V-cut made with the firmer chisel. Then change to a very thin paring chisel to make rolling cuts as you follow the arcs scribed on the edges. When the carving is done, hold a coping saw blade so that it will cut on the pull stroke and snap off the far end. File or grind down the toothless edge to a jabbing point that will let you start the blade in the holes that you drilled earlier.*



It's not the sawing – so much as it is the stopping sawing! *The framed French rip saw that Roubo would have used hangs on the wall. The two scraper blades tucked in the lower, completed kerf will help keep the vise from prematurely snapping the joint apart. When all seems ready, check with your knife to see that all the cuts are truly free. You can ensure even leverage on the first separation by taking the blades of two framing squares (or the like) and slipping them into the kerfs on either side of the hinge. Twist them both equally and think of France. You never forget your first time!*

industrial piecework system. But just as the aristocrats were now a thing of the past, so too it seemed was the ancient aristocracy of craft.

Reddened though they were, Roubo's 51-year-old eyes were still good enough to recognize the dignitaries making their way up to the "altar of the nation," preparing for the main event. There was Talleyrand, and Mirabeau, and there, amid the flags, was a character from one of his books! A young girl, all in white, had joined the upping ante of notables. In her hands was a Bible, a Bible resting on the one-piece walnut folding bookstand from plate 331 of his "L'Art du Menuisier." Well, at least his writing had accomplished something!

Then, riding in on a white horse, was Lafayette himself, the former Marquis, now citizen-commander of the National Guard. Back from helping the Americans win their revolution, he was the embodiment of hope for the fragile stability of the moment. After suitable benedictions and inaudible pronouncements, the "hero of two worlds" touched his sword to the altar of the nation and led the mass assembly in swearing allegiance to the new French constitution. Five hundred thousand voices joined in to shout "I swear!"

André Roubo's coughing was no more than a crackling leaf amid the thunder of cheers and celebratory cannon fire that followed. He would live another six months. **PWM**

Roy is the host of the longest-running woodworking show on television, "The Woodwright's Shop," on PBS.

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IN OUR STORE: *The eight benches in Roubo's shop are pictured in Plate 11, which we offer as a poster that's suitable for framing.*

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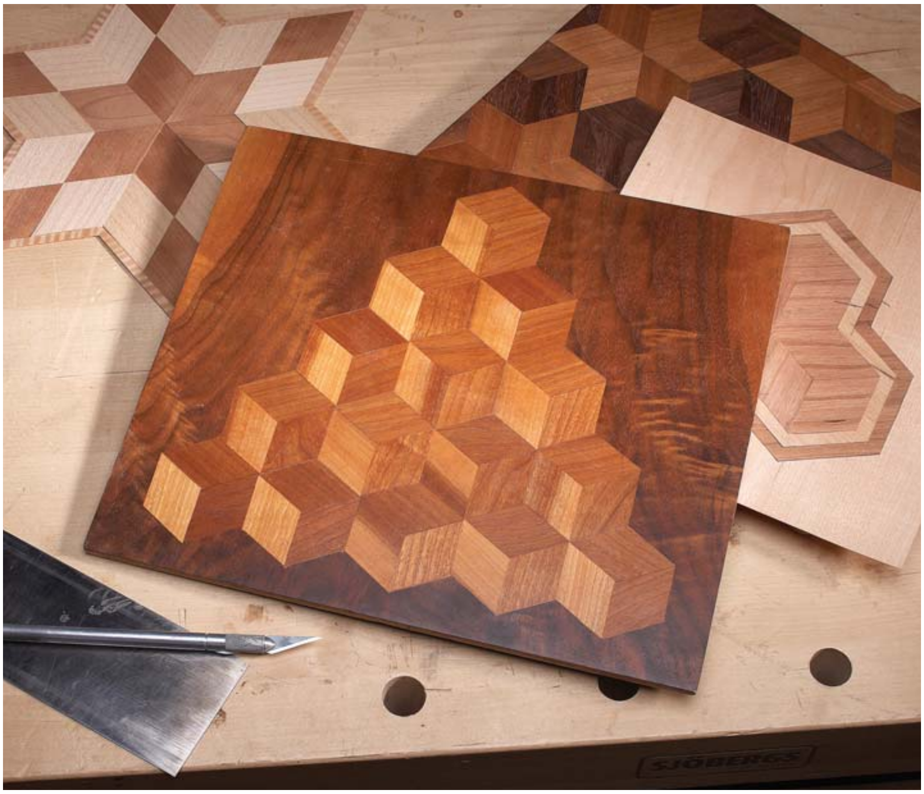
A Geometry Lesson in Veneer

BY MARC ADAMS

Part 4: Louis cubes are a simple form (really!) of parquetry that is easier to make than it looks.



Cutting cubes. *Louis cubes are a simple geometric parquetry pattern that you can easily cut into any sheet of veneer.*

Parquetry is cutting veneer and arranging it geometrically. By cutting and taping geometric pieces together in some fashion, a veneer project can come to life.

If we cut diamond-shaped pieces at a 60° angle we can make something called Louis cubes. Louis cubes are created by arranging three pieces of veneer together to produce the mesmerizing effects of 3-dimensional cubes. This same diamond shape can also be used to create a star arrangement. The stacking potential is endless. I do recommend that you have at least two or more colors of veneer. Try to avoid veneers with difficult grains such as red oak, lacewood and wenge.

Cutting Louis Cubes

1. Start by cutting several strips of veneer with the grain that are the exact width of your straightedge (mine is made from Corian). Contrast will be important, so cut strips of at least two or more types of wood.

2. With masking tape, tape these strips edge to edge.

3. For this next cut, the face that has masking tape should be facing down away from you. With a 30°-60°-90° triangle, align the bottom edge of the triangle (the short side of the right angle) in exact line with the bottom edge of the veneer packet. It should run with the grain. This will place the 60° side of the triangle (the hypotenuse) running up the veneer packet. Holding the triangle tightly on

Simple strips. *Make sure you are not cutting strips longer than your straightedge. My strips are about 12" long.*

Don't skimp on tape. *Make sure the seams are tight and that the masking tape covers the entire length of the seam. This will create a packet of several taped strips.*

PHOTOS BY AL PARRISH

the veneer, make a cut through the entire length of the veneer packet.

4. Once the packet has been cut at a 60° angle, align your straightedge perfectly with the cut 60° edge. This will allow you to make strips that are the exact width of your straightedge through the remaining packet at a 60° angle to the grain.

5. Remove the tape from each of these strips to reveal the 60° diamonds. I separate species into individual piles.

6. By taking six of these diamonds (three of one color, three of another) you can arrange them into a star shape.

7. By taking three pieces (two of one color, one of another) you can arrange them create a box that looks as if the top is open. With masking tape, tape the three pieces together to complete the Louis cube. Make sure the seams are tight.

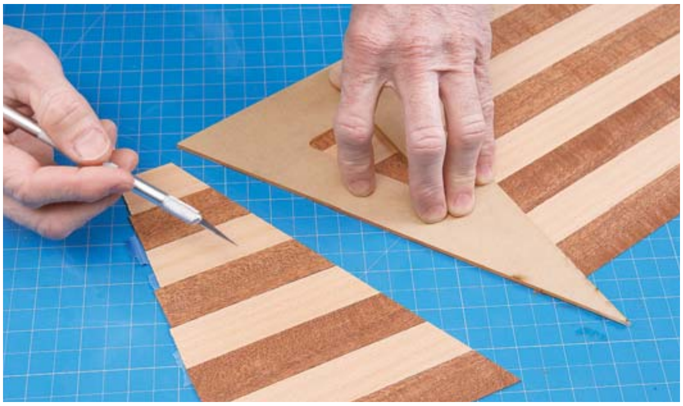
8. With masking tape, tape these three Louis cubes together to create a pyramid shape (as shown at bottom left).

9. These three cubes when taped together create a parquetry packet that can be cut (inlayed) into a piece of veneer. With the show face of the veneer facing down (you will be looking at the glue face with no tape on it) set the Louis cube parquetry packet anywhere you wish on the veneer with the masking tape facing up (toward you). Go ahead and use masking tape and tape the parquetry piece directly on the veneer. Register the piece with a pencil mark that laps the inlay and veneer.

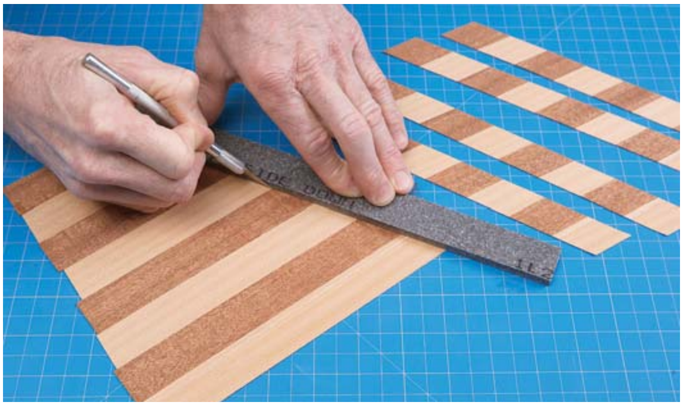
10. The next step is to cut the parquetry piece into the veneer sheet. I do this with an X-Acto knife. I let the knife ride against the parquetry piece, but if you feel better using a straightedge then that is fine. Make sure you start and stop each cut at the exact corner of the parquetry pattern on top – don't overcut. It might take a pass or two with the knife to completely cut through the veneer below. And it's perfectly fine to cut through the masking tape that is holding the parquetry image down.

11. Use the pencil mark reference to align the parquetry in the correct position in the veneer sheet. Use masking tape on the glue face to hold the parquetry image temporarily in place. Flip the veneer sheet over to the show face and finish taping the parquetry into place with veneer tape. Cover all the seams.

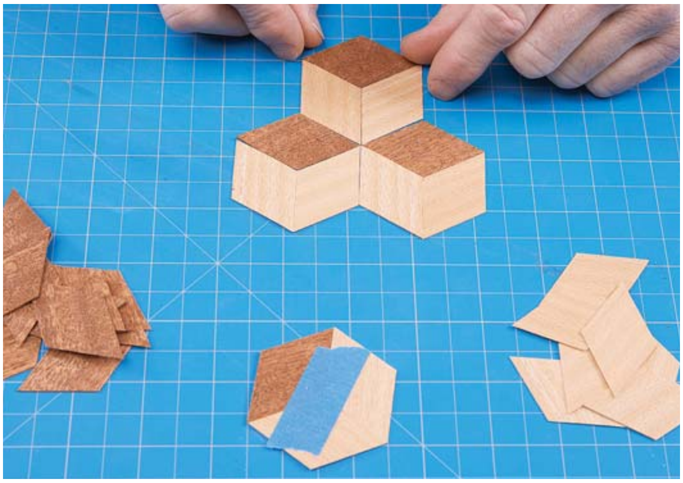
> *"Men admire the man who can organize their wishes and thoughts in stone and wood and steel and brass."*
>
> — Ralph Waldo Emerson (1803-1882)
> American essayist and poet



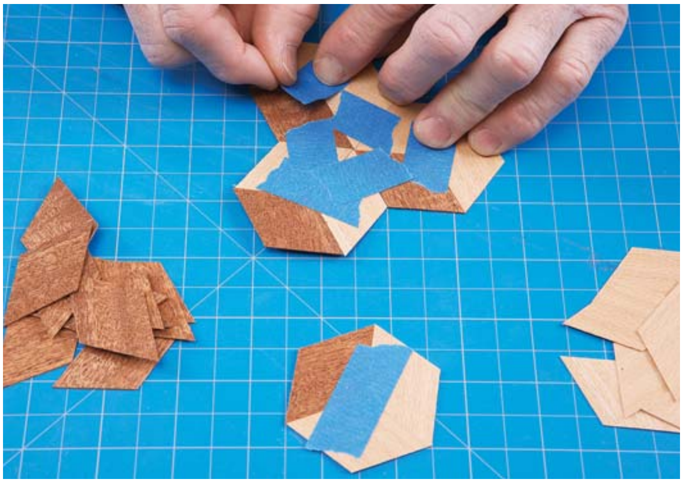
One angled cut. *This cut will be across the grain of the entire strip packet and will require several passes with the knife.*



Back to the straightedge. *Cut several strips with your knife and straightedge. Take care to ensure the strips are the same width as your straightedge.*



See the illusion? *By using only one color of veneer for the sides of the cube and a second for the top, it creates the illusion of an open box.*



Tape it tightly. *Tape at least three Louis cubes together and set that aside. Do not use veneer tape yet, because the water will cause each piece to curl which would affect the next few steps.*

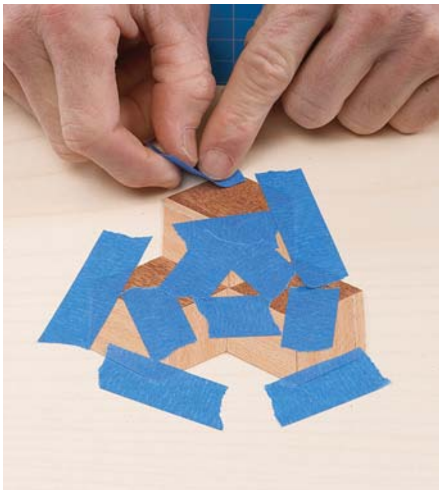
12. Flip the veneer sheet over to the glue face and remove the remaining blue tape. Because we just added water to the show face through the veneer tape, it might be best to put the veneer panel under weight until the water dries out.

13. We'll need a veneer sheet as a backing to balance this panel, so if you have enough extra veneer, make another panel using the same process but maybe with different arrangements of the veneer.

Glue the Panel to the Coreboard

My 3⁄4" MDF panel has already been edgebanded and is ready to have the face and backing veneer pressed on. This project will need veneer on both surfaces to keep it balanced. Before gluing I first make sure the surface is free from debris and irregularities, and verify that there is nothing on the surface that could inhibit the glue from sticking.

For a simple pressing such as this one, I prefer to use plain old white glue. It will dry clear, has a reasonable working time and is somewhat repairable if problems develop from pressing. Keep in mind that glue will stick only where glue is, so it is important to cover the entire surface of the core. I always do a rehearsal first to make sure everything is ready. There's nothing worse than spreading the glue then having to find some clamps. Remember – in gluing veneer it's best to put the glue on the core and not on the veneer because the moisture will cause the veneer to curl. Do not thin the glue.


Secure for slicing. *Tape the parquetry packet to the veneer sheet. With a pencil put a reference mark on the parquetry piece and on the veneer. This will help locate the parquetry piece after it has been cut into the veneer sheet.*

Apply the Glue

1. Gather all the supplies necessary for gluing, including the pressing system that you intend to use. Spread paper over the area where the glue will be applied.

2. There are a lot of efficient ways to spread glue, and the amount of surface area to be covered helps me to decide what method I will use. The key is that the glue should be spread evenly and thinly over the entire core surface. This project is a perfect application for a 4" foam roller.

3. Once one side of the core is covered with glue, apply the veneer with the veneer tape facing you. Don't glue the veneer tape face (the show face) down.

4. Flip the coreboard over so the veneer that we just applied is facing down. Because there is glue on this side it is good to have newspapers down to protect the veneer from any squeeze-out. The weight of the coreboard will help keep the veneer flat. Also remember at this time not to dally because we have glue that is already starting to set.

5. Repeat steps two and three for the second side.

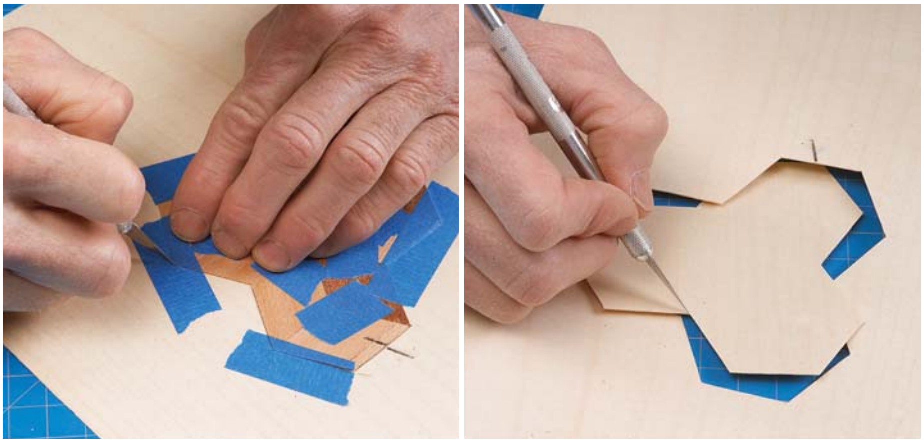
6. Once the core has veneer glued on both faces, take some masking tape and apply a few pieces over the edges at the corners. This will keep the veneer from sliding and shifting during the pressing process.

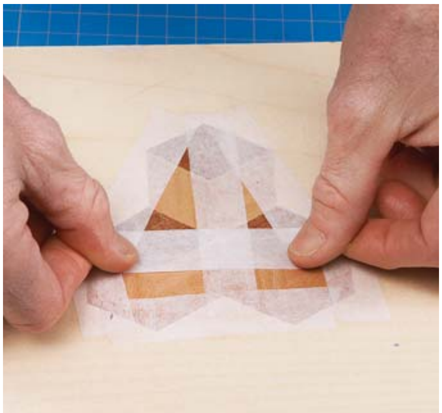
Time to go Into the Press

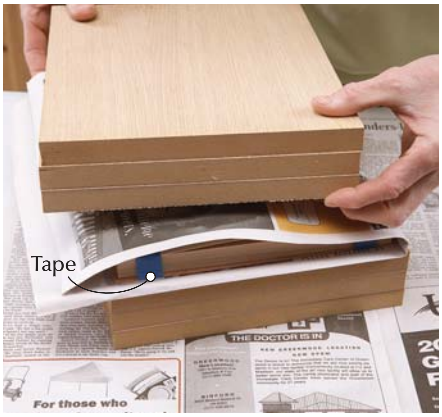
If you are fortunate enough to have a friend that has a vacuum press, make sure he or she remains on your Christmas card list. Vacuum bags are the easiest way to press veneers. However, because most people don't have a vacuum system, we will discuss the process for simple caul pressing. The key to successful pressing is proper planning and patience. Make sure that you allow the glue to cure before removing any project from the press.

1. I start by covering the panel with several layers of newspaper. This will help absorb excess water from the glue and act as a sponge to help ensure that pressure is distributed everywhere over the panel. Try to avoid newspaper with lots of color, which can bleed into the veneer. Make sure that there are no wrinkles in the newspaper as you cover the coreboard.

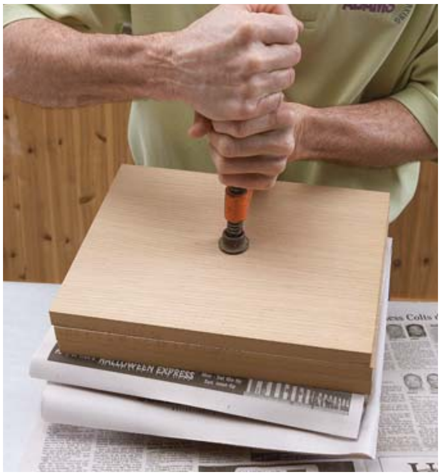
2. Ahead of time I have cut six caul boards out of 3⁄4" particleboard that are about an inch or so larger than our core-


Cut, flip and trim. *Continue to cut until the entire parquetry shape has been cut into the veneer (left). The parquetry piece will now be free from the veneer and as you try to knock out the cut-out you might have to play a little game of connect the dots before it pops out (right).*

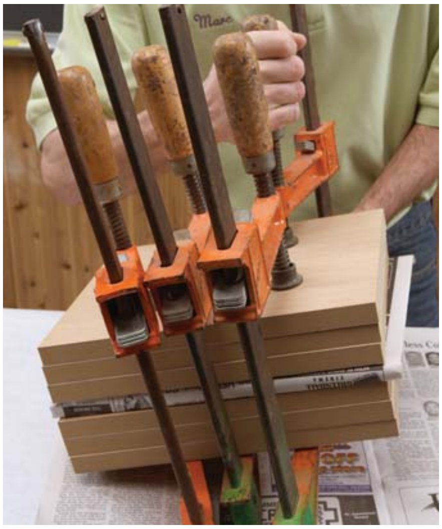

Like a puzzle. *Place the parquetry packet into the hole you just cut in the veneer. Tape it in place. Flip the work over and apply veneer tape to the show face as shown here.*



A little tape helps. *It's important to use only a little tape in the corners and make sure that it follows the grain of the veneer; this tape isn't fun to clean up so don't overdo it.*



Begin in the middle. *The first clamp should be placed as close to the center of the caul boards as possible. This will help squeeze the glue from the center of the panel and help it flow to the edges. Plus it will lock the entire lot together so sliding will no longer be an issue.*



Clamps all around. *Clamps should be spaced about 3" or 4" apart. Use as many clamps as it takes to completely cover the surface of the caul boards.*

board (13" x 13"). Three of these will go on the top and three will go on the bottom.

3. It might be good to get an extra set of hands to help with the clamping process. The veneer, glue, newspaper and coreboard can all slip and slide in different directions, so try to keep the entire lot level and flat. Start by placing the coreboard with the newspaper in between the middle of the six caul boards.

4. I triangulate the placement of each clamp as I arrange them on the cauls, working from the center to the edge. Clamps should be spaced about 3" or 4" apart. Use as many clamps as it takes to completely fill the surface of the caul boards.

5. If time is not an issue, let the lot sit overnight. If time is an issue, let it sit for at least two hours before removing the clamps.

Cleanup

Well, here we are at the moment of truth. This is where it gets fun. Go ahead and remove the clamps from the package along with the newspaper and masking tape that was used to keep the veneer from shifting. Make sure you peel the masking tape at a right angle to the grain. Rub your hands over both the face and back of the coreboard to make sure the veneer pressed flat. If there are wrinkles, try taking an iron and ironing the surface. Because white glue is a thermoplastic material, it can be softened and reactivated. If the surface is flat you are ready to remove the veneer tape.

Because we used white glue I don't recommend that you use water to loosen the water-soluble veneer tape. This could cause the glue underneath to let go. Instead, use a scraper to scrape off as much of the tape as possible. Even though the scraper is sharp it will seem dull as it cuts through the tough veneer tape. Once about 80 to 90 percent of the veneer tape is off, we are ready to move on to the sanding process. It's not a good idea to try to remove the veneer tape by sanding alone because the veneer tape and wood have different densities. The veneer tape is much harder to sand than the veneer itself, and would cause unevenness on the surface. It is better to scrape off most of the veneer tape.

I start with a random-orbit sander loaded with #150-grit sandpaper. Make sure that you sand the entire surface and don't concentrate on just the veneer seams or the parquetry image. I work from one side to the other across the entire panel. After all the veneer tape is off, move on to progressively finer sandpapers using the same sanding motion as before. Finish with #220-grit paper then vacuum or lightly blow off the surface.

Your first veneer project is now ready to be finished and hung as a trophy in your shop. **PWM**

Marc is the founder of the Marc Adams School of Woodworking (marcadams.com).

Scrape and sand. *Remove most of the veneer tape with a scraper. Then switch to a random-orbit sander.*

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Upgrade Your Cutterhead

BY GLEN D. HUEY

Segmented knives reduce tearing and noise. But do you need to upgrade both planer and jointer?

Before you commit, get the facts. *If you fantasize about upgrading your jointer or planer cutterheads, you have a few questions to answer. Because there are cutterheads and cutterheads with shear, you have to be sure you're choosing the right design. Or maybe you're simply not a candidate for change.*

If you purchased your jointer or planer a couple decades back, or if you had a watchful eye on your woodworking budget as you made your purchases, chances are your machine has a three-knife cutterhead installed. Did you choose wisely? Should you make a change? Today you have other options.

Other cutterhead options most common to home woodworkers and small production shops have small square knives spaced around the diameter and along the length of the cutterhead.

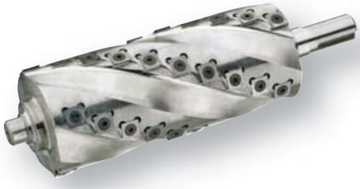
These cutterheads reduce the noise in your shop, mill figured woods better than straight-knife heads and make dust collection easier. However, they are more expensive and require installation in an existing machine. Is one option better than another? Is changing your cutterhead worthwhile?

The Correct Terminology

These new and advanced heads are often incorrectly referred to as spiral or helical.

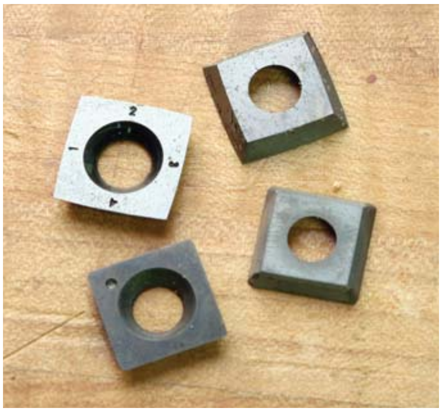
To understand what a true helical cutter is, picture an old-time pencil sharpener where there is constant contact with the cutting edge as a cut is made, not individual knives meeting the surface. Helical cutterheads are available, but they are most often found on large machines in industrial or high-production shops.

Along with the three-knife cutterheads, we're primarily discussing two types of cutterheads that have multiple knives. These heads should be referred to as either stagger-tooth designs or stagger-tooth-with-shear designs. Heads in which the knives are set at an angle and cut in a shearing action are known as stagger-tooth-with-shear heads (as shown in the opening photo). Designs in which the knives meet the wood at a 90° angle – similar to the three-knife setup in that



Small pieces. *These knives all meet the wood at a 90° angle, as do the knives in a three-knife cutterhead. It's as if the long knives have been segmented and remounted.*

LEAD PHOTO BY AL PARRISH; STEP PHOTOS BY THE AUTHOR



Choose wisely. *These knives are different in size and thickness, and the larger knife's edge is sharpened at a curve.*

they chop as they cut – are simply called stagger-tooth cutterheads.

Get a Scorecard

Of course, the three-knife cutterhead is a well-known design, but, because there are dozens of stagger-tooth cutterhead designs available, we focused on two that best represent the majority available: a Grizzly cutterhead is our cutterhead with knives that meet the wood straight on, and a cutterhead from Byrd Tool is our stagger-tooth-with-shear head.

Common to both stagger-tooth designs are the individual knives. These knives are micro-grain carbide on which all four edges are sharpened for use. Some manufacturers deem carbide knives made in Germany as the best, but I'm told there are also companies that produce high-quality knives in Switzerland and the United States. All these companies are getting the raw materials from the same source, and according to one cutterhead manufacturer, the differences in quality are negligible.

How do the carbide knives compare to the high-speed steel (HSS) knives used on most three-knife heads? The short answer is that the carbide edges last longer – but there is much more to discuss.

The length of the HSS knives is as long as the cutterhead and are they generally called out by the machine's width – an 8" jointer has 8"-long knives and a 15" planer has 15"-long knives. The width and thickness of the HSS knives vary with any given machine. Some knives, such as those in a Delta 8" jointer (DJ-20), are 13/16" wide x 1/8" thick, but the knives for Powermatic 8" jointer (60C) are 11/16" x 1/8".

Knives on a three-knife cutterhead design can be shifted left and right to cancel out nicks temporarily, but they eventually need to be pulled from the machine, sharpened then re-installed. Setting the knives level with each other and the jointer table or the bed of your planer is an arduous process that can result in hours of downtime. After HSS knives are sharpened numerous times, they reach a point where they are too narrow to be used in the machine. However, after 20 plus years of woodworking, my knives have not yet reached that point.

It's possible to get a sharper edge honed on the single cutting edge of HSS knives than on a carbide cutter, but the degradation of that HSS edge is quick to a point then it slowly and evenly degrades until it needs additional work.

Carbide knives begin less sharp than HSS knives – the particles of carbide are too fragile and break if honed to too fine of an edge – but the wear to the cutting edge is slow, and a good-quality cut is maintained over a longer period of time. As the knives near dull, degradation becomes quicker as the carbide particles wear away.

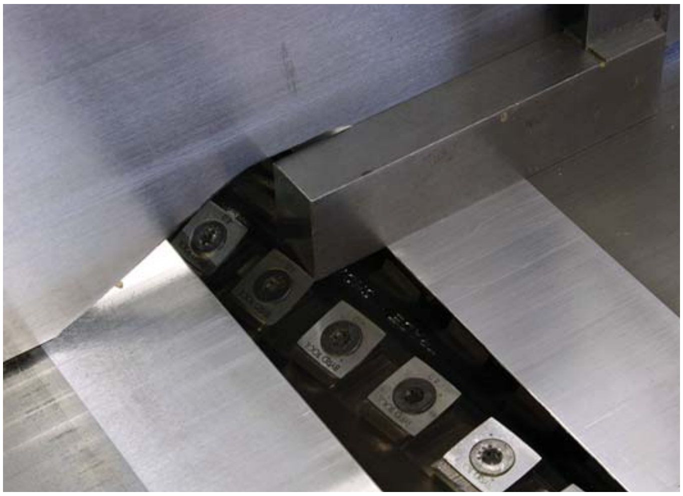
I know of a professional shop that sharpened its HSS knives every six months. After a stagger-tooth head was installed, the shop has gone just more than two years without rotating the knives. That's a huge savings of time and money. Given this scenario, many home-based woodworkers might never need to rotate a knife and surely wouldn't use all four cutting edges of carbide knives – provided they didn't abuse the cutterhead by milling wood with undiscovered nails and other defects.

Carbide knives for the stagger-tooth cutterheads we're looking at are primarily found in two sizes. The Byrd cutterheads use 15mm square x 2.5mm-thick knives that are ground with a slight curve along each edge and are set to meet the wood at an angle. This combination, along with accurate positioning of the knives, creates the shearing action in the cut.

The Grizzly knives are 14mm square x 2mm thick and are sharpened without the curve. Knives hit the wood straight on.

When the carbide knives get nicked or are dull, you rotate the knife a quarter

Goodbye micrometer. *The tediousness of dialing in the perfect setting as you change traditional knives is eliminated when using a stagger-tooth cutterhead.*



Now shear this. *A simple indication that your cutterhead cuts with shear is to examine the knives. If a knife is angled as it meets the workpiece, you've got a shear-cutting head.*

turn and present a new sharp cutting edge to the wood. There is no alignment work necessary to level the knives with the outfeed table on your jointer or the bed in a planer. Changeover is quick.

As with any cutterhead, it's important to clean any waste from behind or beneath the knives. With small square carbide knives, even the smallest particle can keep the knife from proper seating, which would produce tracks on your wood.

Examine the Cut

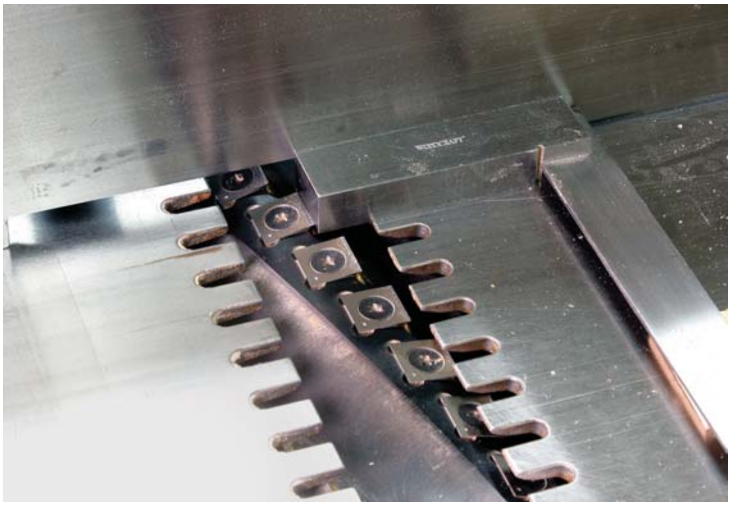
If you run a board through a planer with HSS knives, the milling marks will run the width of your workpiece. You might notice lines that run the length of your board, but those are from the nicks in your blades. The side-to-side milling lines are from the full-width knives pounding the wood as they cut.

The cut from a stagger-tooth head produces lines that run the length of your workpiece. On a Byrd head, the knives are aligned in five spirals (sometimes called wings) with each knife making a cut on the wood. This is known as a "single-effective" cut. With a stagger-tooth-with-shear cutterhead, the knives produce a slight scallop as they cut due to the curve honed onto each cutting edge of the knives. The amount of curve would be equal to the depth of the scallop, except that the knives overlap as they cut.

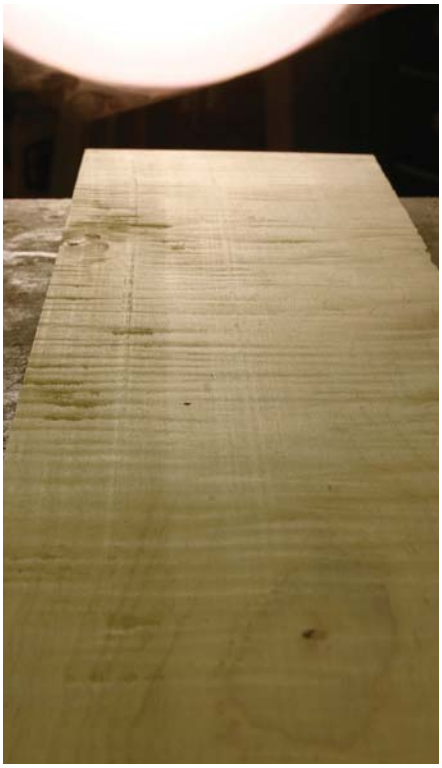
Each knife laps the previous knife by about one-third. As a result, the scallop is so small that it is seen only in raking light and felt with your fingertips, but it's nearly impossible to see with the naked eye. It is also easily removed when sanding or planing for your final surface (you do know that straight from the jointer or out of the planer is not your final surface?).

The Grizzly heads also leave mill marks that run the length of the workpiece. Due to the position of the knives on the cutterhead, some knives cut exactly in a previous knife's cut; this is known as a "double-effective" cutterhead.

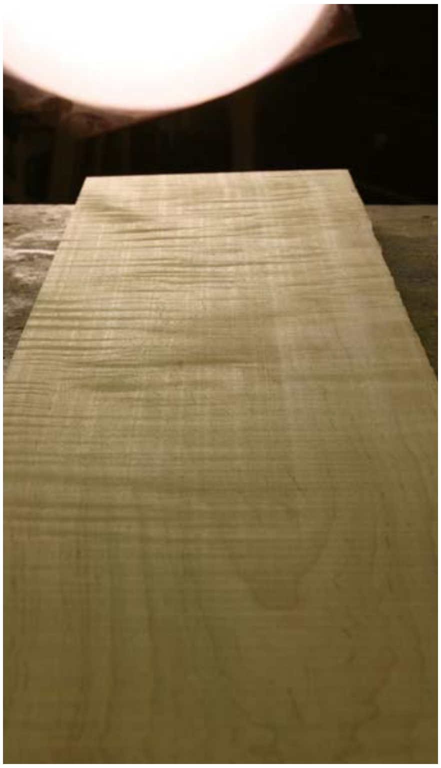
In a double-effective design, which most of the Grizzly heads are, there is an



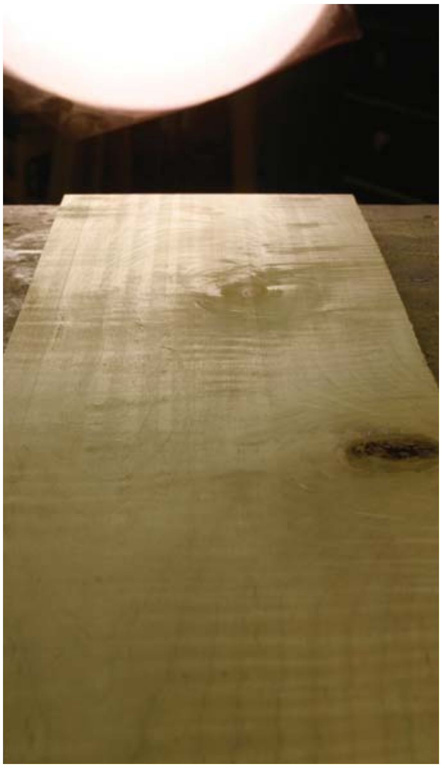
Straighten up. *With the knives on a simple stagger-tooth head meeting the workpiece straight-on, there is no curved cutting edge needed.*



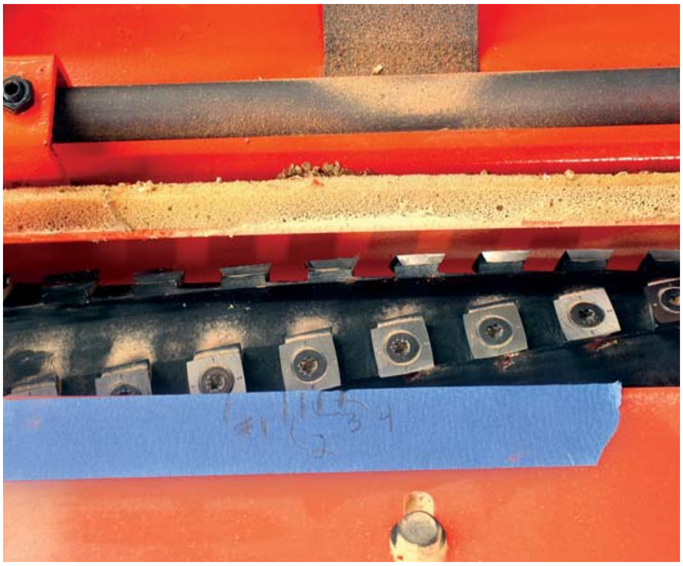
Two problems. *With traditional knives, the lines along the length of the board are the result of nicks in the cutting edges. The tear-out is another problem altogether.*



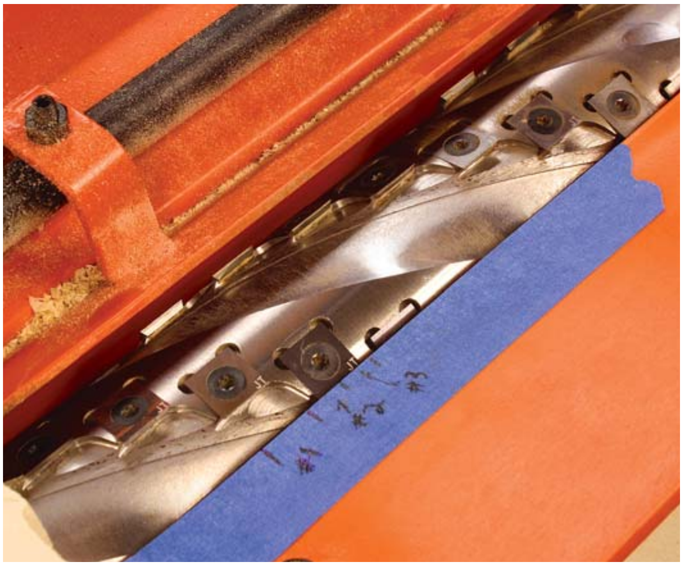
Dragging the line. *Curved knives on a stagger-tooth with shear cutterhead produce small scallops that are seen in a high-raking light. These are removed easily from your final surface.*



Uniform rows. *A raking light clearly shows the consistent texture left after a cut with a stagger-tooth cutterhead. Without the light, the rows are almost invisible to the eye.*



Single-effective. *The Byrd head has the knives set so that each takes a slice of wood. Overlapping of the cuts is about one-third.*



Unique knives. *Evaluation of the knife locations on a stagger-tooth head shows no overlap in the cut, but hides the fact that some knives line up.*

even number of spirals. The knives on the first and third spirals are positioned to cut at the same location. Knives on the second and fourth spirals also match, and they are set to cut the area between the knives on the other spirals. To better visualize this arrangement, if you removed the knives from spirals #1 and #3, the resulting cut would be grooves down the length of your workpiece. The grooves would be 14mm wide, with the ridges in between somewhat less than 14mm wide, depending on the specific machine model.

The surfaces left from a stagger-tooth cutterhead in a jointer do not affect edge gluing.

As you evaluate the differences between the three-knife design and the stagger-tooth designs, you may notice that one cut is made in a bevel-down approach (the three-knife cutterhead with the HSS knives) and the other cut is made bevel-up (all stagger-tooths). As it is with handplanes, the wood doesn't care if the bevel is up or down; what matters is the angle of cut at which the edge hits the wood. That angle differs little between all these designs. As a general rule, each design has the knives attacking the wood at approximately a 32° angle, plus or minus, based on the center of the cutterhead.

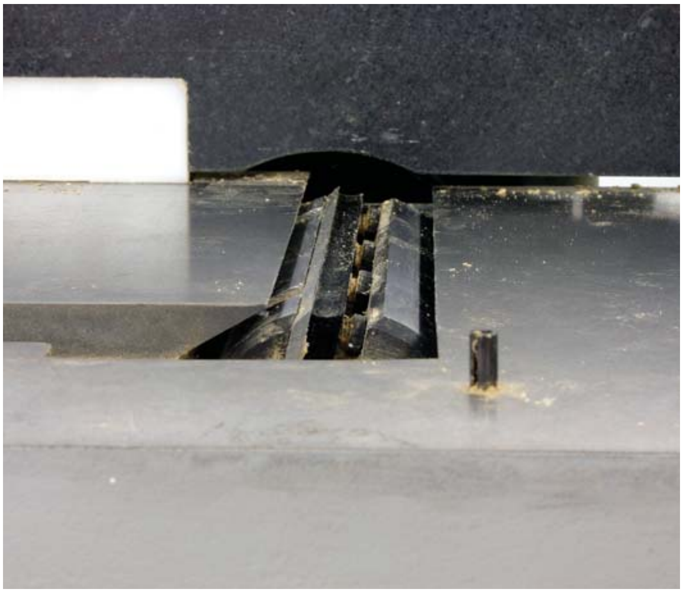
Use Your Head

Single-effective or double-effective – is one better? In heads with matching diameters and lengths, double-effective heads have fewer knives. A 20" head from Grizzly has 98 knives arranged in four spirals – two spirals have 25 knives that stretch to the ends of the cutterhead, and two spirals have 24 knives spaced to span the entire surface. A 20" Byrd cutterhead has 100 knives, 20 on each of five spirals. Fewer knives should translate into less horsepower required to make the cuts, but in cutterheads with shear the knives are set at a slight angle, and that reduces the amount of force needed to plow through the cut. The biggest difference is that double-effective heads make a cut over an area that has already been partly cut. That cut has to be an easier task.

Take a look at a Byrd head and you'll see it's black, but the Grizzly heads and all the three-knife cutterheads that I've seen are not. Is the black a better grade of steel? Does it make a difference in the cut? No. The difference is that Byrd heads are treated with black oxide to aid in rust prevention. Nice touch, but I've never had to clean rust from my cutterheads. Have you?

A Couple Side Benefits

Whenever stagger-tooth cutterheads are discussed, one main benefit is usually brought up: noise reduction. The stagger-tooth design divides the cut so that the



The angle of attack. *With a bevel-down arrangement, you might think the knives in a three-knife cutterhead meet the wood at a different angle. However, the geometry is very similar.*

individual knives' impacts on the workpiece are reduced as compared to the straight-knife head. This results in a reduction in noise and vibration of the workpiece.

It's almost impossible to get a true reading on how much lower the noise level is with a machine rotating a stagger-tooth head versus a three-knife head. Unless you have identical machines set side by side, you're not comparing apples to apples.

A couple years back, I was amazed at the noise difference between a 12" Bridgewood jointer with a stagger-tooth head and that of a 12" Delta DJ-30 with a three-knife head. The difference was 8 decibels. Scientific types know exactly what the means – I know the noise was significantly less with the stagger-tooth setup.

Years back when the *Popular Woodworking* shop jointer was changed from a three-knife head to a stagger-tooth head, Editor Christopher Schwarz said the difference was astounding. Given the amount of time we spend at these machines, a reduction in noise over the long haul has to be beneficial.

Another benefit that might be missed in a quick study of cutterheads is easier dust collection. As I worked with each of these designs, I paid particular attention to the waste coming from the cutterhead. There is a noticeable difference between a three-knife head (one continuous knife cut) and a stagger-tooth head with its many knives at work. In fact, I don't have my jointer hooked into dust collection because I was constantly pulling the hose to unblock a clog.

> *"Every contrivance of man, every tool, every instrument, every utensil, every article designed for use, of each and every kind, evolved from very simple beginnings."*
>
> — Robert Collier (1885-1950)
> American author, publisher

The chips come off three-knife heads in long strands as shown in the photo below left. By comparison, the chips from the other two heads are much finer and don't clog hoses as readily.

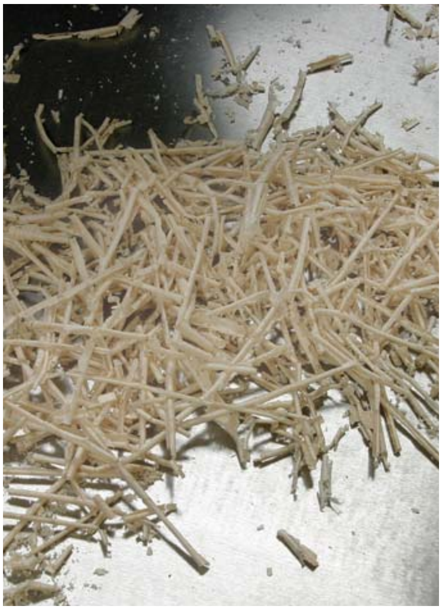
An interesting point when studying the waste shavings is to understand the shavings produced by a shearing cut from those from a non-shearing cut. If you take a look at the photo directly below, you see the results from the Byrd cutterhead. Notice that the shavings curl slightly and are only as long as the knives are wide. Contrast those shavings with the material coming from a stagger-tooth cutterhead (right).

The Kool-Aid is Poured

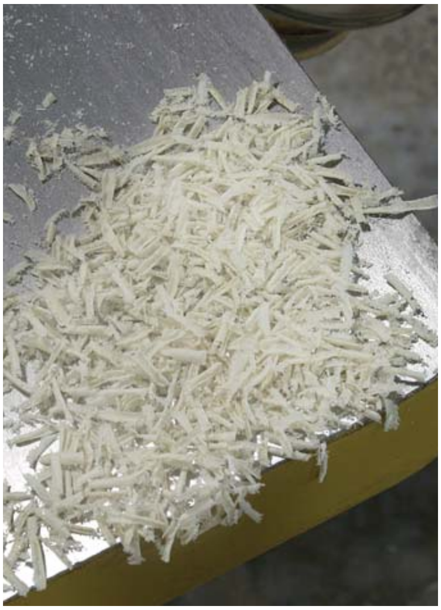
Is a stagger-tooth cutterhead in your future? This is, after all, what you want to know, right? The first thing I would do is to toss costs out the window. If you add up what it takes to sharpen your knives as well as the time spent to dial in the exact setting, over the long term things balance out. Besides, when I'm in the shop I want to build. Money spent on a new cutterhead is saved in production time. I think the answer depends on what kind of wood you work and how you work it.

We've mentioned that both stagger-tooth head designs are better at working figured wood, the more gnarly, the better. If you seldom work with highly figured woods and find yourself building pieces made from straight-grained lumber, I don't think you're a candidate to change from a three-knife setup. If, on the other hand, your lumber of choice is figured woods or even woods with difficult grain, you should consider moving to either of the stagger-tooth cutterheads. Do you find yourself fighting tear-out on a regular basis? If so, it's time for a change. If you fall somewhere between those extremes, you have to decide if you need to change your head.

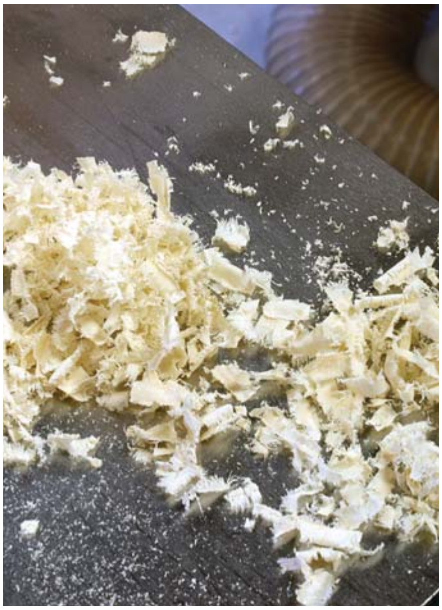
The bigger question is whether you need a stagger-tooth head only in your planer or is it necessary to have one in



Looks like straw. *Shavings from a three-knife head can be as long as your workpiece is wide. That's a surefire recipe for clogged dust collection.*



Clog-free collection. *Stagger-tooth cutterheads produce shavings that are only as long as the small knives. That's also an indication of why tear-out is minimal at worst.*



Appears the same. *At first glance, shavings from the straight-knife stagger-tooth setup look like those from the shearing cut, but there is no curl in this waste.*

your jointer, too? If you have reached the conclusion that a stagger-tooth cutterhead makes sense for your planer, then in order to decide if you need to upgrade your jointer, you have to examine how you mill lumber.

If you mill you lumber in the standard way, I don't think it's necessary for you to also change the knives in your jointer. Proper milling dictates that you flatten one face then move to your planer to thickness the stock. With a stagger-tooth head in your planer the second face is flattened with the benefits of the many knives. Once the two faces are parallel, you should begin to flip faces with each pass through the planer. Ultimately, both faces are milled using the stagger-tooth head. Even if you experience tear-out at the jointer, the planer will mill both surfaces smooth.

If you buy rough stock then "hit/skip" it through your planer to read the grain, and you leave barely enough thickness to mill to final dimensions, then you might benefit from having a stagger-tooth head in your jointer for the same reason that a woodworker who purchases lumber that is $^{13}/_{16}$" and already surfaced on two sides.

In either of these scenarios, you don't have the material to remove significant tear-out. There is enough thickness for a single pass over your jointer to flatten one face then it's off to the planer to thickness the workpiece in one pass.

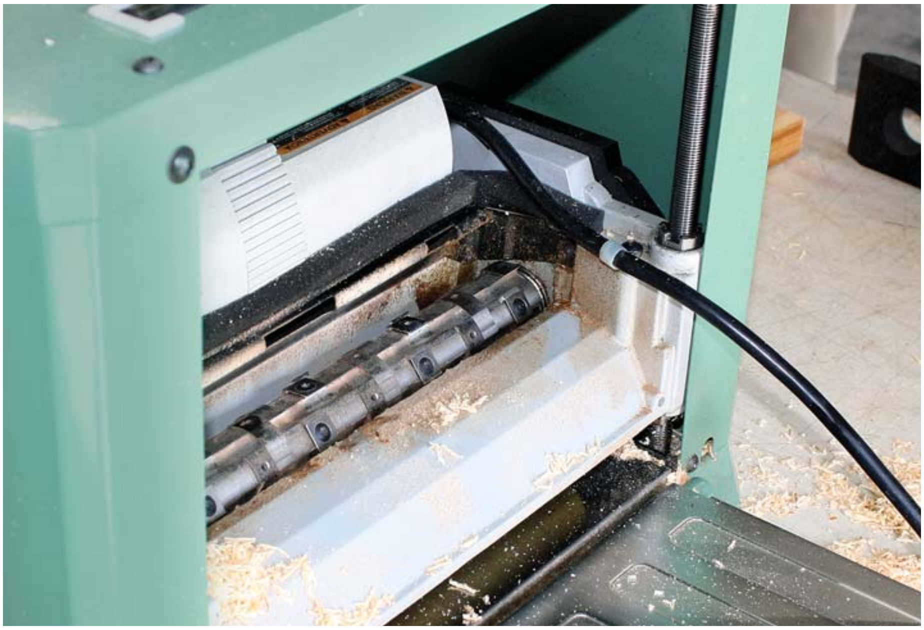
It is not helpful to have your jointer set up with a stagger-tooth head while your planer remains in three-knife mode.

Changing Knives & Dust Collection

When changing carbide knives when necessary, it's important to make sure that the knives and their pockets are clean even when rotating to a new cutting edge. Any debris between the knife and the pocket could cause the carbide to break as you tighten the screws.

The screws holding the inserts in place must be tightened properly. The most reliable method is to tighten the screws to the torque recommended. Inconsistent tightening of screws will result in small variations in insert location which may result in visible ridges in the wood.

Also, the inserts need to be handled carefully. Extra inserts should be stored in containers or boxes when not being used. If inserts are left unprotected, it's likely that the edges will be damaged.



Also a stagger-tooth. *This segmented head (the entire head is made up in sections) is another stagger-tooth variation in which the knives meet the workpiece at 90°.*

In these two stagger-tooth designs, you'll notice a difference in the actual pockets milled into the heads. On the Grizzly heads, the knives are supported on three sides. On the Byrd head the knives are supported only at the back. The space between the knives, according to one manufacturer, acts like the gullet on a saw blade. It helps carry the waste from the cut, which keeps the knives cool.

As a result, you should notice a difference in dust collection. When we ran the machines (planers in this case), the Byrd head shot the shavings from the machine. With the Grizzly head, shavings were a bit slower exiting the cutterhead area.

With dust collection attached, neither of these cutterheads should have any problems with shavings build-up.

To Shear or Not to Shear

I have worked each of these stagger-tooth design with straight-grained and softer hardwoods as well as figured woods in hardwoods such as curly maple. I've not noticed enough of a difference to warrant picking one design over the other.

You would automatically think that a shear cut would be the better cut, but that's not always true. When you angle a blade or knife to obtain a shear cut, you effectively reduce the leading edge cutting angle of the tool, be it a handplane or a cutterhead. Therefore, a stagger-tooth cutterhead with shear may not be attacking the wood at the same angle as a simple stagger-tooth head. If that's the case, you may experience more tear-out.

As I researched the information for this article, I became sold on installing a stagger-tooth cutterhead in my planer, but not in my jointer. That's a decision I made based on how I mill lumber. I also like the idea of less down time while in my shop. Now it's your turn to decide. **PWM**

Glen is senior editor of this magazine, and although he considers himself a hybrid woodworker, he leans heavily to the power-tool side of the aisle.

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VIDEO: *Watch the installation of a 20" stagger-tooth with shear into a planer.*

ARTICLE: *Read Glen D. Huey's article about "The Right Way to Prepare Lumber."*

WEB SITE: *Visit Byrd Tool's web site for cutterhead installation information.*

TO BUY: *Grizzly.com has both cutterhead designs available for your machines.*

IN OUR STORE: *"Woodworking Machines (Back to Basics)" by John Kelsey.*

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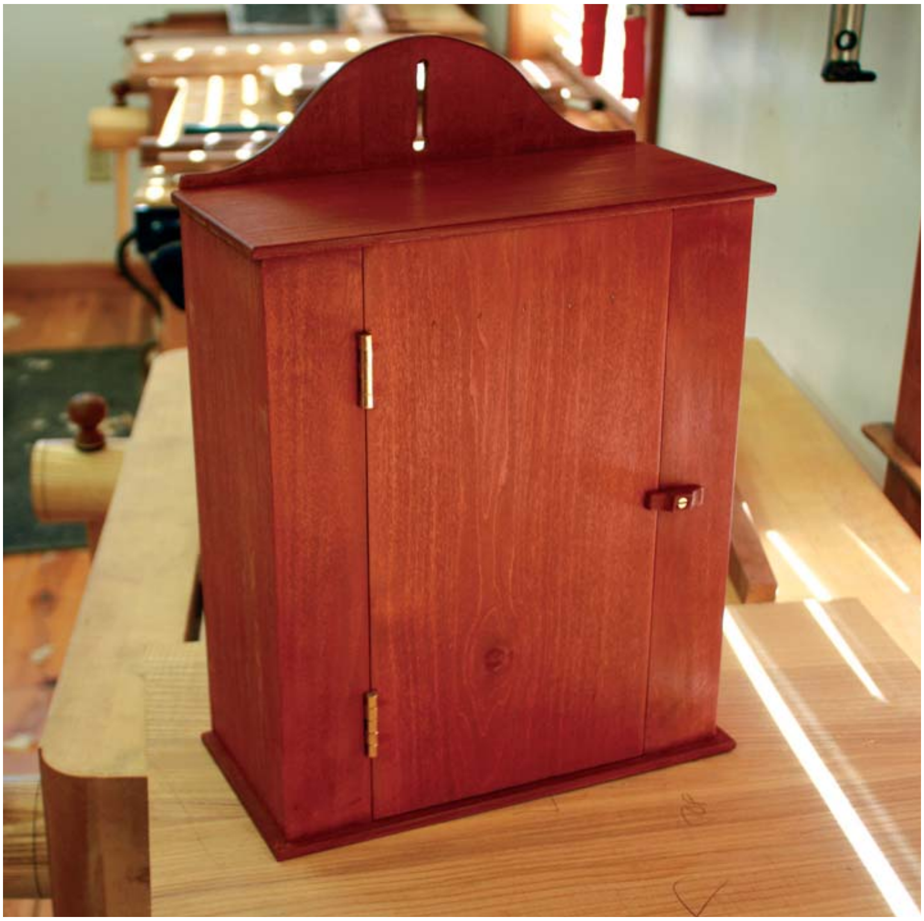
Shaker Wall Cupboard

BY CHRISTOPHER SCHWARZ

A classic form from the New Lebanon Shaker community is easy to build in a few hours.



Simply red. *The original cabinet is cherry with a varnish finish. It looks good in a variey of woods, including this poplar version with a red wash.*

If you don't like nails, then perhaps you should turn the page. This small wall cupboard from the New Lebanon Shaker community bristles with them.

The carcase and stiles are nailed together with cut brads. The back is attached with clout nails. And the door is held flat with battens that are secured by clenched nails. I think the nails add to the piece, and, because there are so many different kinds, this project is an excellent introduction to 19th-century cut nails.

Quick Joinery – Quick Results

I've built quite a few of these cabinets in the last couple years because they are an excellent way to teach someone traditional joinery and they can be made quickly (my father received one last year that I banged out in a day).

Begin with the carcase. The carcase sides are the only pieces that have real joinery. Cut 3⁄8"-wide by 3⁄16"-deep rabbets in the bottom edges of the sides. These receive the interior bottom piece. Cut 3⁄8"-wide by 3⁄16"-deep dados for the shelf.

Glue and nail the sides, bottom and shelf together. I used 2*d* cut headless brads that I set 1⁄32" below the surface.

True up all the edges of the assembled carcase then fit the two stiles on the front. They hold the carcase square. Glue and nail these in place with 2*d* cut headless brads and set those.

The thin top and bottom pieces are each attached in an unusual way. First round over the front edge and ends of each piece. The thin bottom is merely glued on to the carcase. Note that the bottom extends 1⁄4" beyond the back of the carcase, which creates a rabbet for the back. The top is glued and nailed to the stiles and carcase sides (don't worry – it's the back of the cupboard that handles all the weight).

Now deal with the back. Cut the ogee shapes on the top of the back piece. Then cut the slot that allows you to hang this cupboard on a peg or nail. Here's how. Drill a 1⁄4" hole at the top of the slot. Drill a 3⁄8" hole at the bottom. Connect the two slots using a coping saw. Attach the back to the carcase using 2*d* clout nails (no glue).

> *"Apart from panel and veneer pins, the furnituremaker has little use for nails except for softwood work, etc."*
>
> — Ernest Joyce
> "Encyclopedia of Furniture Making"

Keep Your Door Flat

The door is a flat panel of wood. If you don't apply some cross-grain battens to the back, it will warp in short order.

So fit the door in its opening and cut the mortises for your hinges. With the door moving freely, remove it from the cupboard and drill pilot holes through the door and battens for nails.

You will clench these nails, which means you'll bend them over on the inside of the door. I used 2*d* cut headless brads.

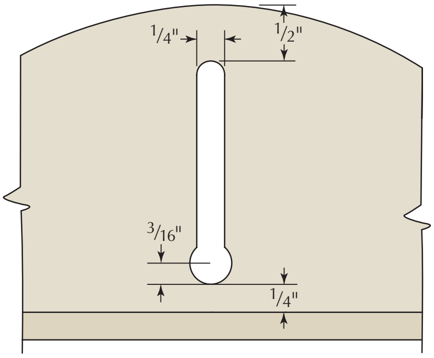
OPENING PHOTO BY KELLY MEHLER; STEP PHOTOS BY THE AUTHOR; ILLUSTRATION BY ROBERT W. LANG

Drive them through the front of the door and through each batten.

When all the nails are driven in, turn the assembled door over onto a metal surface and hammer the tips of the nails. This will bend them over into the wood, securing them. Then cut the hinge gains, hang the door and make a turn to hold the door closed. The original also had a little knob, which is best turned on a lathe.

While the finished cabinet will have too much metal to pass through airport security, I guarantee the nails will help your piece last as long as the original. **PWM**

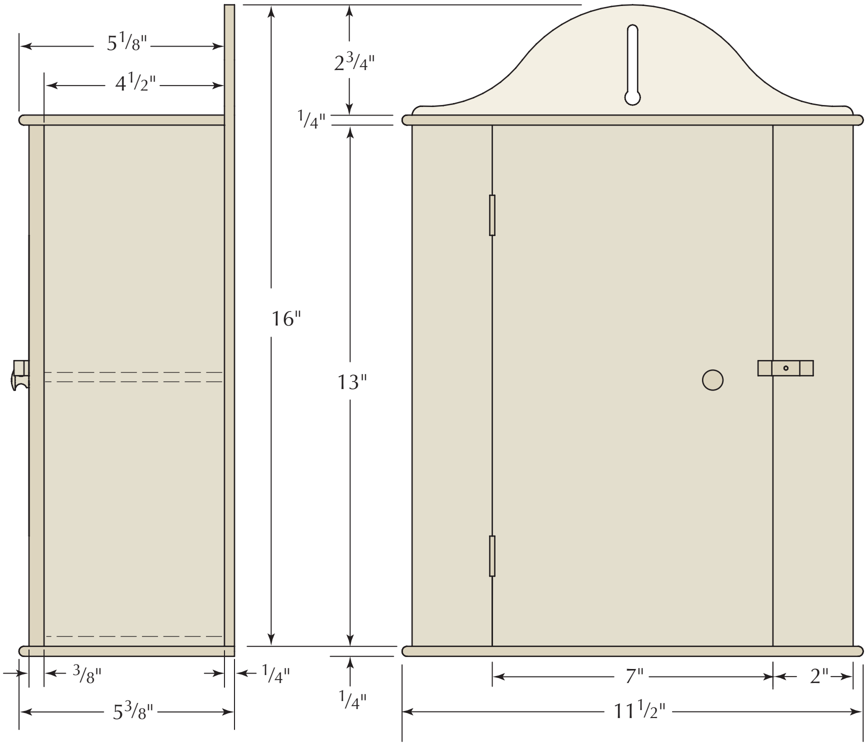
Chris is the editor of this magazine and does not own stock in any nail-making enterprise. He is the author of "Handplane Essentials" and "The Workbench Design Book."



SLOT DETAIL

Shaker Wall Cupboard

	NO.	ITEM	DIMENSIONS (INCHES) T	W	L
☐	2	Carcase sides	3/8	4 1/2	13
☐	2	Stiles	3/8	2	13
☐	2	Shelf & bottom	3/8	4 1/2	10 5/8
☐	1	Top	1/4	5 1/8	11 1/2
☐	1	Exterior bottom	1/4	5 3/8	11 1/2
☐	1	Back	1/4	11	16
☐	1	Door	3/8	7	13
☐	2	Battens	3/8	1 1/2	6 7/8

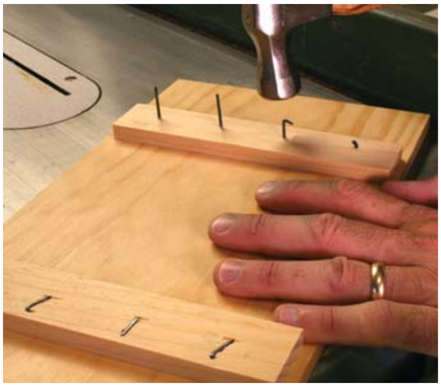


PROFILE

ELEVATION

Get your bottom on. *The thin exterior bottom piece is glued on. Clamp the assembly to your benchtop to help distribute the clamping forces.*

Connect the dots. *Drill a 1/4" hole for the top of the slot and a 3/8" hole at the bottom. Connect the holes with a coping saw.*



Clenching is a cinch. *Drive the tips of your headless brads back into the battens while the door rests on a metal surface.*

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VIDEO: *Watch a video of clenching a nail.*

PLAN: *Build a more complex version of this cabinet using free plans on our web site.*

BLOG: *Read more about how to use cut nails on our editor's blog.*

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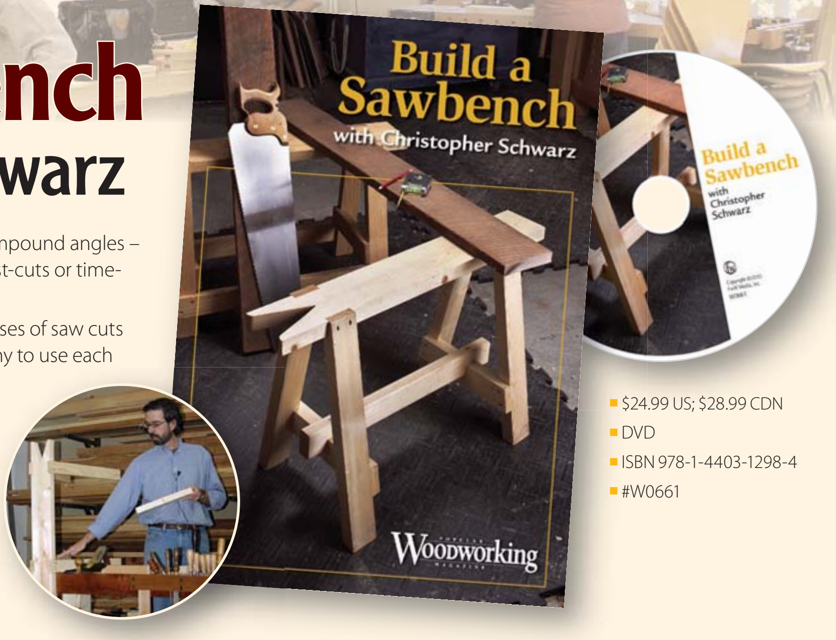

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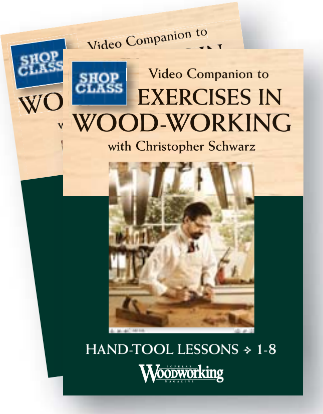

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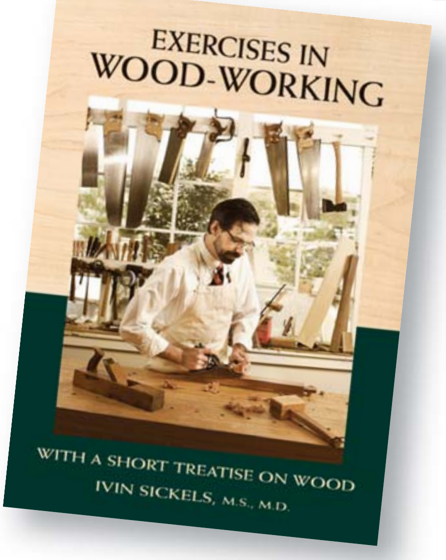

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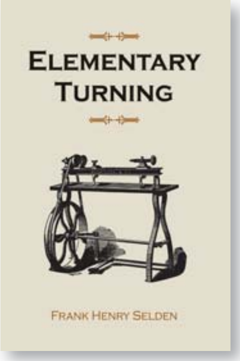

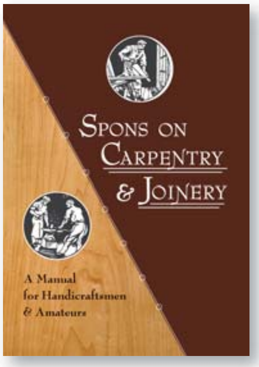
SPONS ON CARPENTRY & JOINERY
A Manual for Handicraftsmen & Amateurs

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When we saw this 1907 book, we simply couldn't resist offering a reprint. Not only is it the best book on basic turning techniques and tools we've encountered (with information that is as relevant today as it was a century ago), the period photographs are charming to look at.

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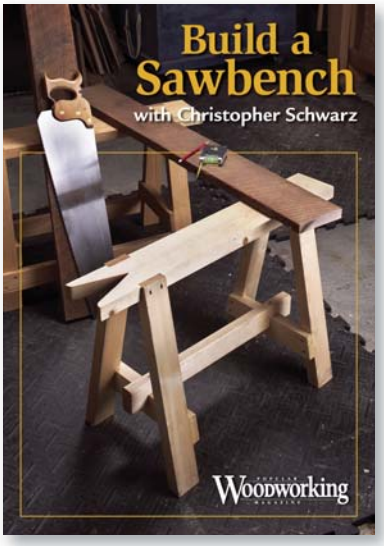
Here, we've excerpted and reprinted all of the woodworking-related chapters from the 1910 edition of the important trade publication "Spon's Mechanic's Own." Not only will you delve into woodworking history, you'll learn a lot about period hand-tool use and technique.

Editor's TOP PICK



'Build a Sawbench'

We filmed "Build a Sawbench with Christopher Schwarz" during a sawbench class in our shop with 10 students – and every one of them finished the project. You too can follow along as Chris teaches you how to build this indispensable appliance for the hand-tool shop. You'll learn, from a student's eye perspective, how to saw with precision and use bench planes, router planes and chisels like a pro as you discover that compound cuts are easier (and faster!) to make with handsaws (there's no fussing around with jigs, test-cuts or time-consuming setups). Plus, the DVD includes a PDf with complete step-by-step instructions, construction drawings and a SketchUp model. And all without me bugging you about your lunch order.

Megan Fitzpatrick

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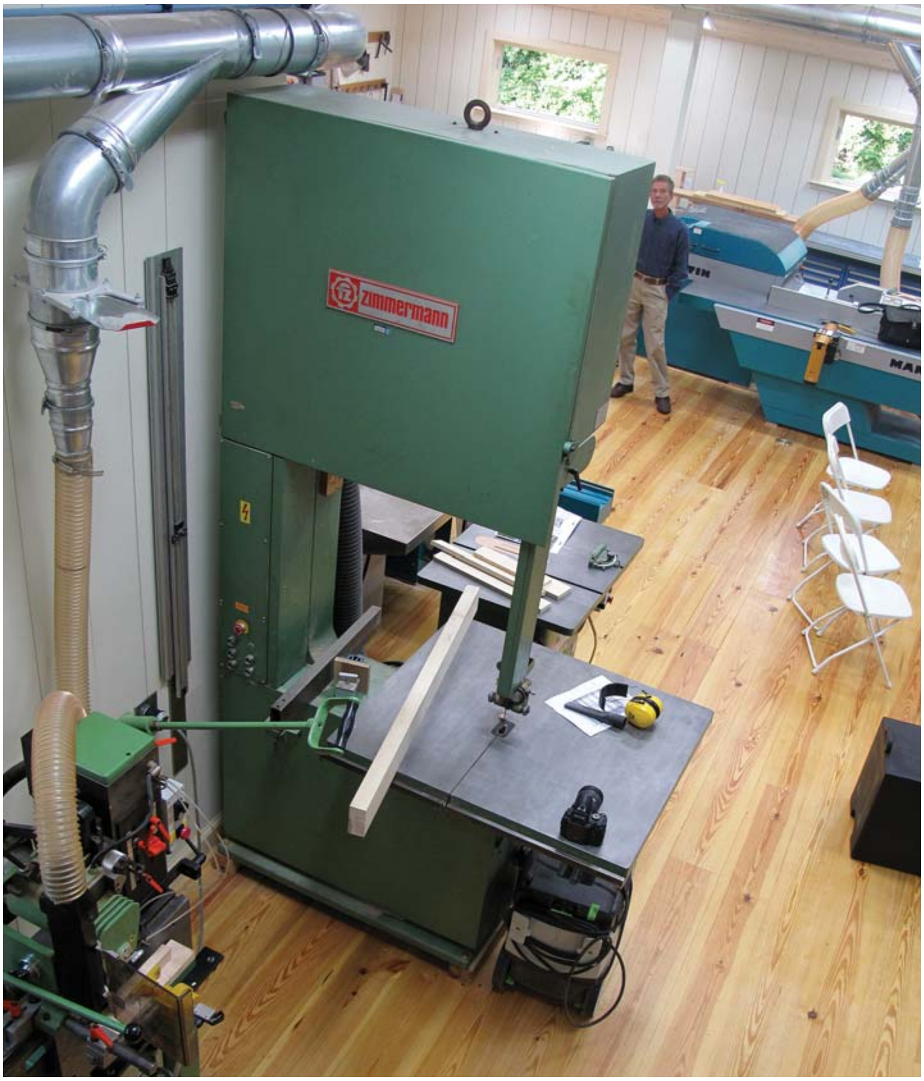
BY CHRISTOPHER SCHWARZ

Living the European Dream

A St. Louis physician spent years assembling the perfect shop.



The other green giant. *At 9' tall, this Zimmermann band saw has more than twice the throat capacity as a typical 14" home shop band saw.*

The problem with many "dream shops" is that their visionaries never wake up and get on with building any furniture.

There's nothing inherently wrong with building a hobby shop and having the shop alone being the hobby, but this magazine is about building wooden things inside a shop. So it seems a waste when I visit a shop that never sees a speck of sawdust.

For the last few years, I've been following the progress of Dr. Kent Adkins, a young surgical urologist outside St. Louis, who has been methodically planning and constructing an 1,800-square-foot shop attached to his home by a breezeway.

It would be easy to assume that Adkins simply picked the machines and tools with the highest price tags for his shop, but that would be an insult to the years of passionate research Adkins and his friends have put into searching the world for tools that are the best in class and safe as possible.

I've seen Adkins on the floor of the International Woodworking Fair, picking apart the features and details of machines, veneer presses and even hand tools. He traveled twice to the Ligna woodworking show in Germany. I've watched him question sales representatives with the insight of a journalist. And in May 2010, I got to operate his crane.

Yes, the man has a crane.

During a warm spring weekend, Adkins opened his new shop to friends, neighbors, family and two editors – myself and Senior Editor Glen D. Huey. During our evening in his shop, we picked through every nook and cranny of his wood-floored soaring shop space, ran his machines (mostly German) and were impressed with what Adkins has accomplished.

A Tour of the Machinery

The shop is L-shaped with three entrances: a door in the breezeway, French doors by his table saw and a folding curtain wall of windows that faces out into his front yard. On a nice day, Adkins can open up this wall and bring in the outside breezes.

As you walk in through this opening, you see an AL-KO dust extractor to the right that Adkins can switch on and off using his iPhone. In front of that is a Kundig edge sander. Off to the far left is a Oneway 2436 lathe. But those machines are almost invisible compared to the huge numerically controlled Martin shaper equipped with an Aigner fence and power feeder. After using Delta and Jet shapers,

PHOTOS BY THE AUTHOR

this Martin is like experiencing alien technology. The throat plate opening around the cutterhead is motorized and closes using eccentric rings. The head tilts 45° both ways. And when you look up, you see three more Martin machines – a T45 planer, a T54 jointer and a T60 sliding table saw.

If you ever go to one of the big industrial woodworking shows, be sure to stop by the Martin booth. The company's planer (which can handle almost 25") boasts that it can remove up to 7⁄16" of material in one pass. We were skeptical. So Adkins ran a thick white oak board through the machine. The Martin didn't protest and the board emerged perfect.

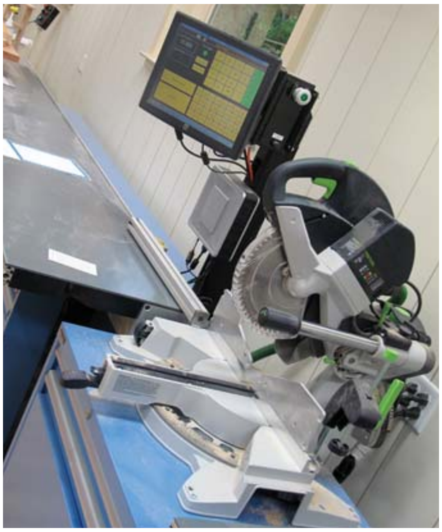
The jointer handles boards almost 20" wide, has a motorized infeed table and a SUVAmatic guard, which is remarkably different than the North American "porkchop" guard. The jointer begs to be used. And we obliged. It's like having endless power and endless capacity.

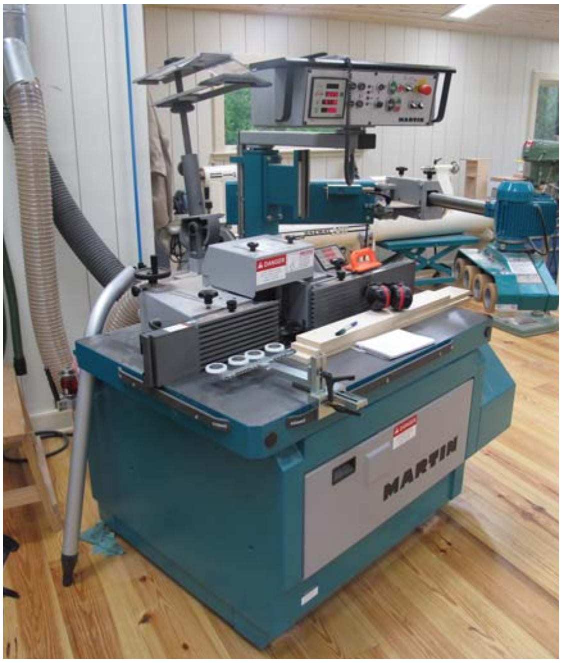
Behind the major machines is the bench area, which looks out onto a garden through bay windows. Flanking the bench are two band saws, a small 24" Agazzani band saw and the largest band saw I've ever seen in a home shop – a Zimmermann with a 31" throat – a machine that barely vibrates when you power it up.

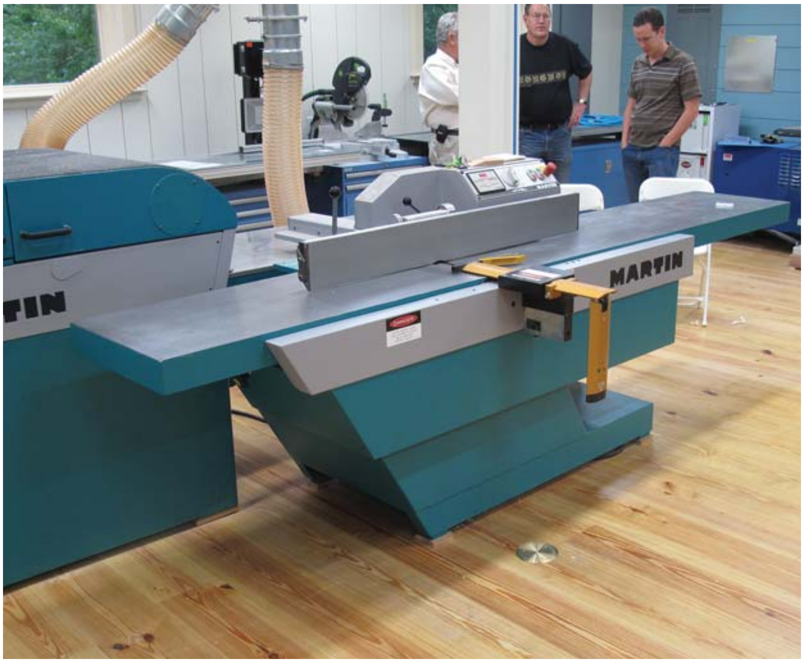
In the far corner is a Festool miter saw that is paired with a RazorGage system, which I had never seen before. Here's how it works: Punch in the length of the stock you want, and the device moves the stop to that exact point. It's also programmable to handle your entire cutting list.

The last major machines are a Kundig 43" wide-belt sander and a Maka mortiser, which uses a "swing chisel" to cut mortises and is impossible to describe with words. (We've provided a link to a video at the end of this article.) All along the walls of this corner of the shop are Lista storage cabinets filled with hand tools that are almost all French-fitted into their drawers, plus there is a dedicated area for sharpening hand tools here.

In pleasant surroundings. *Adkins's shop is at the end of a quiet cul-de-sac surrounded by trees and a garden.*


Finely chopped. *The computerized RazorGage stop system on this Festool miter saw setup makes cutting stock to length a breeze.*


A shapely shaper. *This Martin shaper makes smaller machines look like toys. It features a head that can tilt both ways.*


How wide? *This Martin jointer can handle boards up to almost 20" wide.*

Above all these machines is a loft where Adkins stores his wood, plus the small remote-controlled crane that allows him to bring his material to the shop floor.

And There's More

The door at the far end of the shop leads to a smaller room that features a flat-screen television and video equipment that allows Adkins to watch woodworking videos while he's not building in the shop. And off to the left of that is a nice bathroom with a shower.

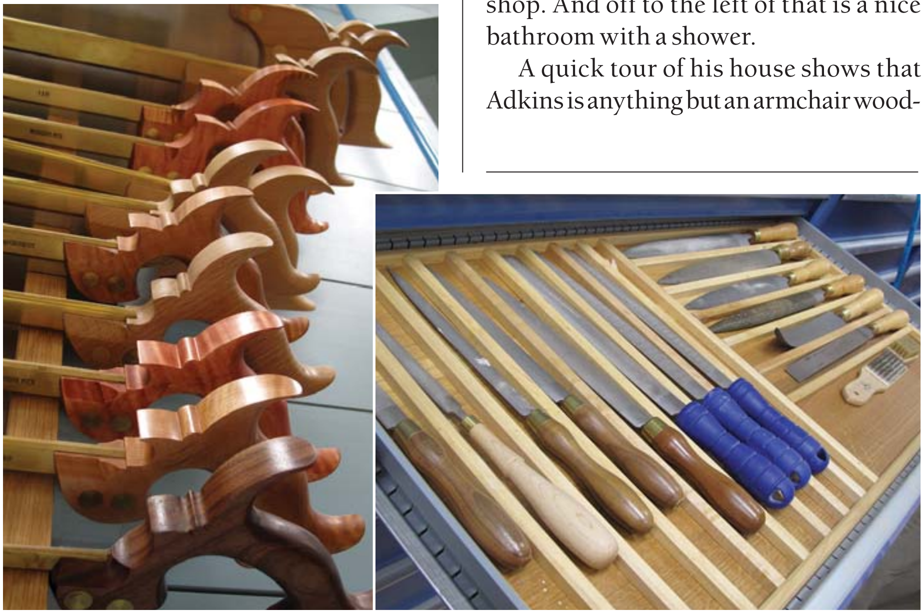
A quick tour of his house shows that Adkins is anything but an armchair woodworker. His house is filling up with the the things he has built, from an enormous kitchen table based on Sidney Barnsley's work to a cannonball bed he turned on his Oneway.

Since our visit last May, Adkins has kept in touch with us via e-mail, but these e-mails are entirely different than ones he sent us before. They are all photos of the work he has been churning out from his shop and the plans he's drawing up for future projects. Adkins has turned his passion and enthusiasm toward his furniture work and away from the means to make it.

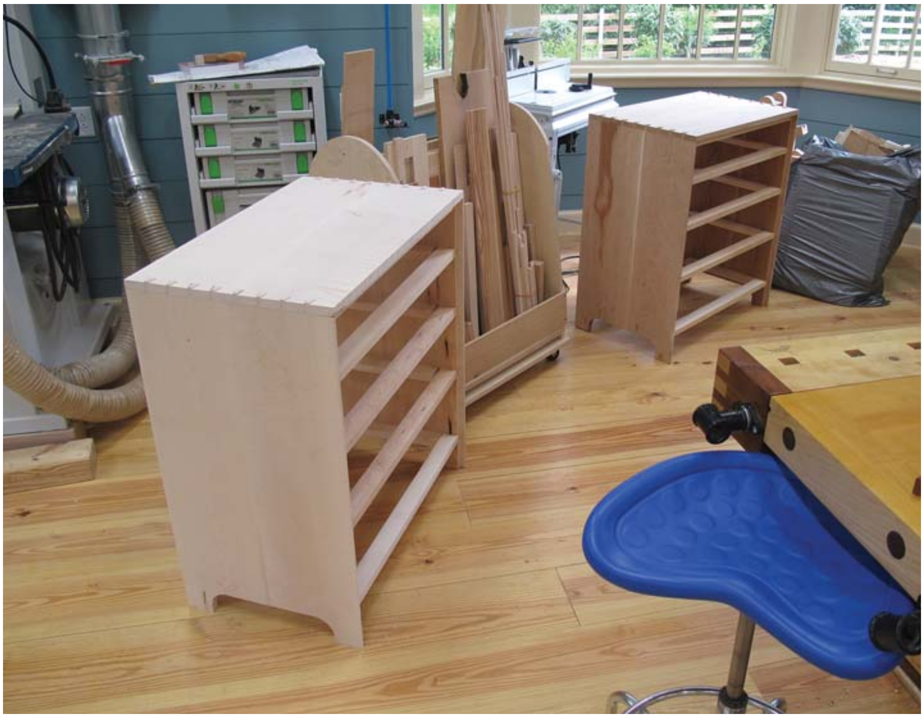
"Some people play golf. Some people collect fancy cars," Adkins said while standing in his shop. "This is what I do. I make things."

My day in his shop really made me rethink my own 375-square-foot shop at home. I built it 10 years ago but never finished off the concrete floor, cinderblock foundation or open stud walls. But last summer I vowed to change all that to make it a place as inviting as Adkins's. I added a white oak floor. Drywalled the studs. Covered the cinderblock in beadboard and traditional moulding. And I painted everything with care. It's a much nicer place as a result. And though I don't have room for a crane, I can still dream about one. **PWM**

Christopher is a long-time journalist and the editor of this magazine – but he's wondering if it's too late to go to medical school.



I saw that. *As much as Adkins likes power tools, he also has a fine assortment of hand tools that he uses on his projects.*



In the works. *In the bench area are two dressers Adkins was building for his children. They were built using a combination of hand and power techniques.*

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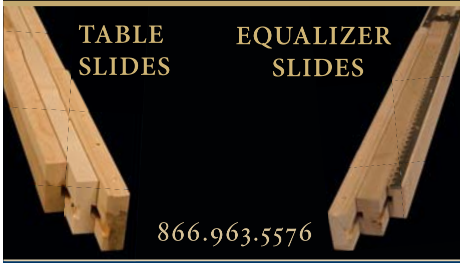

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BY BOB FLEXNER

Finishing Overview

Understand the basics.

A wood finish is a clear, transparent coating applied to wood to protect it from moisture and to make it look richer and deeper. This differs from paint, which is a wood finish loaded with enough pigment to hide the wood. And it differs from a stain, which is a wood finish and a colorant (pigment or dye) with a lot of thinner added so the excess stain is easy to wipe off. The remainder just colors the wood; it doesn't hide the wood.

Unfortunately, the term "finish" also refers to the entire built-up coating, which could consist of stain, several coats of finish (a "coat" is one application layer) and maybe some coloring steps – for example, glazing or toning – in between these coats. For some reason, we have only one word to refer to both the clear coating used, and to all the steps used.

Usually, the context makes clear to which is being referred.

Purpose of a Finish

A finish serves two purposes: protection and decoration.

Protection means resistance to moisture penetration. In all cases, the thicker the finish, the more moisture resistant it is. Three coats are more protective than two, for example. Boiled linseed oil, 100 percent tung oil and wax will dry soft and gummy, however, so all the excess has to be wiped off after each application to achieve a functional surface. Therefore, no significant thickness can be achieved. Protection is limited with these finishes.

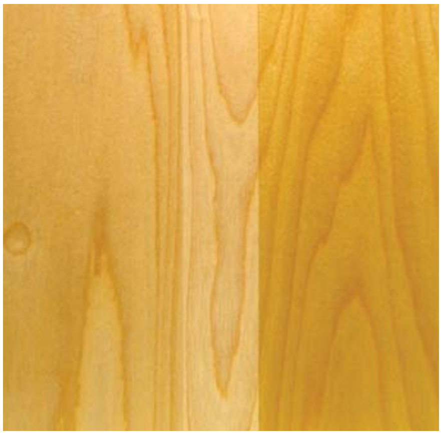
Finishes decorate by making wood look richer and deeper. The impact is less dramatic on unstained lighter woods such as maple and birch, and greater on stained and darker woods such as cherry and walnut.

Types of Wood Finish

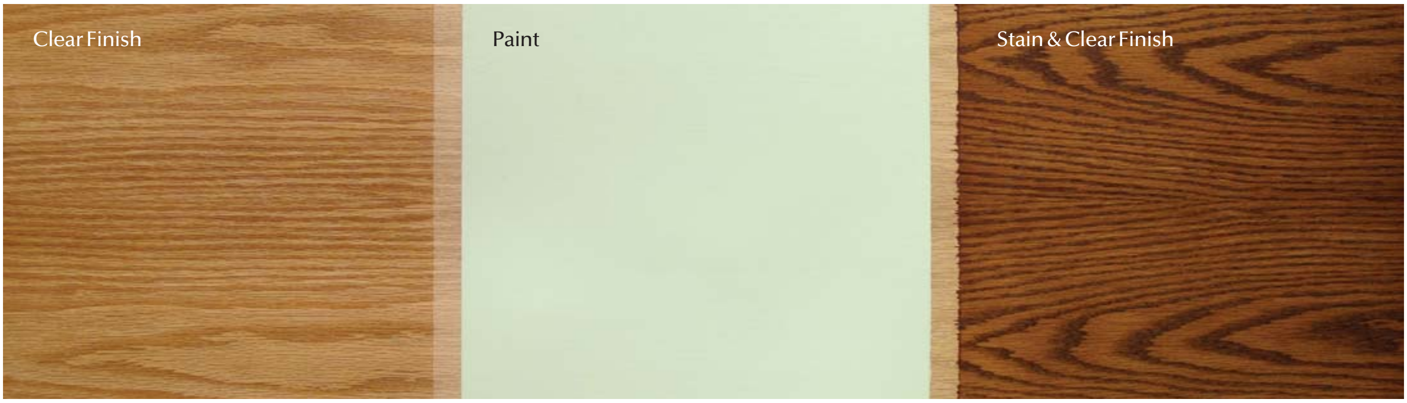
Common categories of wood finish include the following:

- *Oil* (boiled linseed oil, 100 percent tung oil and blends of these oils and varnish).
- *Oil-based varnish* (including alkyd, polyurethane, spar, wiping and gel varnish).
- *Water-based finish* (a finish that thins and cleans up with water).
- *Shellac* (an ancient finish derived from resin secretions of the lac bug).
- *Lacquer* (the finish used on almost all mass-manufactured household furniture made since the 1920s).
- *A large number of two-part, high-performance finishes* used in industry and by many professional cabinet shops.

Wiping varnish is alkyd or polyurethane varnish thinned about half with mineral spirits so it's easy to wipe on and wipe off. You can make your own, or there are a large number of brands, which, unfortunately, are poorly labeled. (Refer to "The Basics of Wiping Varnish" on the magazine web site for more information.)



Polyurethanes. *The left section of this panel was finished with water-based polyurethane, which, like all water-based finishes, adds little color to the wood. The finish just makes the wood a little darker (compared to the lighter strip down the middle, which was covered with tape). The right section was finished with oil-based polyurethane, which, like most finishes except water-based finishes, adds some degree of yellow/orange coloring to the wood. Oil-based polyurethane continues to darken as it ages, while water-based polyurethane doesn't darken.*



Finish on oak. *On this oak panel, a clear finish was applied to the left section, paint to the middle section and a stain and clear finish to the right section.*

CONTINUED ON PAGE 58

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CONTINUED FROM PAGE 56

The primary differences in the finishes are as follows:

■ *Scratch, solvent and heat resistance.* Oil-based varnishes and high-performance finishes provide the best scratch, solvent and heat resistance. Water-based finishes are next. Shellac and lacquer are susceptible to all three types of damage. Oil is too thin to be effective.

■ *Color.* Water-based finishes add little color to the wood. All other finishes (except possibly CAB-Acrylic) add some degree of yellow-to-orange coloring.

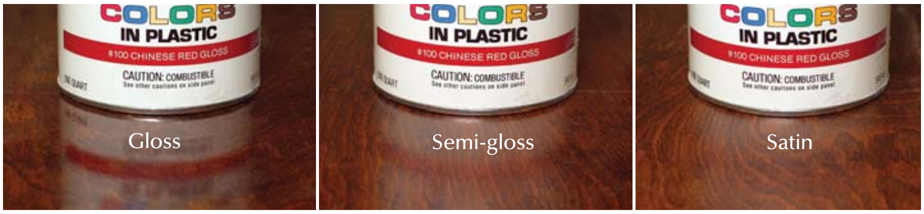
■ *Drying time.* Shellac, lacquer and high-performance finishes dry the fastest. Water-based finishes are next. Varnish and oil require overnight drying in a warm room.

■ *Solvent safety.* Boiled linseed oil and 100 percent tung oil are the least toxic finishes to breathe during application because they don't contain solvent. Water-based finishes (thinned with water and a little solvent) and shellac (thinned with denatured alcohol) are next. Oil-based varnish thins with mineral spirits (paint thinner), which some people find objectionable but which isn't especially toxic. Lacquer and high-performance finishes thin with solvents that are the most hazardous to be around.

Sealing Wood

The first coat of any finish seals the wood – that is, stops up the pores in the wood so the next coat of finish (or other liquids) doesn't penetrate easily. This first coat raises the grain of the wood, making it feel rough. You should sand this first coat (with just your hand backing the sandpaper) to make it feel smooth. You don't need a special product for this first coat unless you have one of two problems you want to overcome.

■ Alkyd varnish and lacquer can gum up sandpaper when sanded, so manufacturers of each provide a special product called "sanding sealer" with dry lubricants added to make sanding easier and speed your work. Sanding sealers weaken the finish, however, so you should use them only when you're finishing a large project or doing production work.



Sheen. *A finish can have an infinite number of sheens depending on how much flatting agent is added.*

■ Sometimes, there are problems in the wood that have to be blocked off with a special sealer so they don't telegraph through all the coats. These problems are resinous knots in softwoods such as pine, silicone oil from furniture polishes that causes the finish to bunch up into ridges or hollow out into craters, and smoke and animal-urine odors. The finish that blocks these problems ("seals them in") is shellac, and it should be used for the first coat. Notice that, except for resinous knots, the problems are associated with refinishing.

Sheen

Oil-based varnishes, water-based finishes and lacquers are available in a variety of sheens, ranging from gloss to flat. All sheens other than gloss are created by the solid-particle "flatting agents" manufacturers add to the finish. The more flatting agent added, the flatter the sheen. These flatting particles settle to the bottom of the can, so you have to stir them into suspension before each use.

You can get any sheen you want by pouring off some of the gloss from a can in which the flatting agent has settled (don't let the store clerk shake the can) and blending the two parts. Or you can mix cans of gloss and satin to get something in between. You will need to apply the finish to see the sheen you'll get. It's the last coat you apply that determines the sheen (there is no cumulative effect), so you can experiment with each coat.

Finish Application

Oil, wax, wiping varnish and gel varnish can be applied with a cloth or brush, then wiped off. The other finishes are usually applied with a brush or spray gun.

Brushing is simple – essentially no different than brushing paint. Spraying is also simple, but spray-gun care and tuning is more complicated, and spray guns and their sources of air (compressor or turbine) are considerably more expensive than brushes.

Application Problems

Common problems and ways to avoid them:

■ *Brush marks and orange peel.* Eliminate these by thinning the finish 10 percent to 30 percent so it levels better.

■ *Runs and sags.* Watch what is happening in a reflected light and brush out the runs and sags as they occur.

■ *Dust nibs.* Keep your tools, the finish and the air in the room as clean as possible.

■ *Bubbles.* Brush back over to pop the bubbles, or thin the finish 10 percent to 30 percent so the bubbles have more time to pop out.

No matter what the problem, you can always fix it by sanding the finish level and applying another coat. **PWM**

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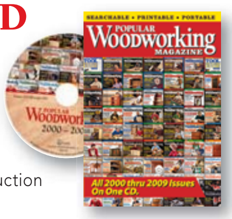
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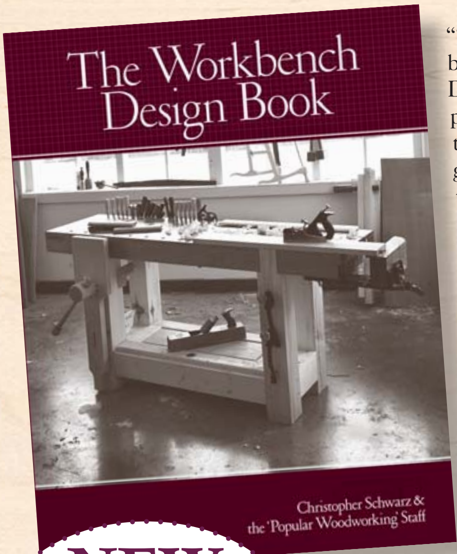
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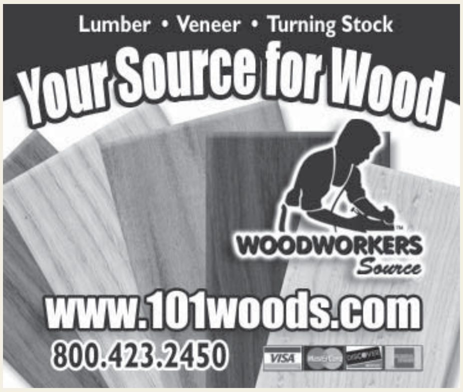

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GLOSSARY

Woodworking's lexicon can be overwhelming for beginners. The following is a list of terms used in this issue that may be unfamiliar to you.

awl (n)
A pointed metal hand tool, usually with a wooden handle, used for piercing or marking. Awls designed for marking out are called "scratch awls." Awls for making holes are typically called (among other things) "brad awls" or "birdcage awls."

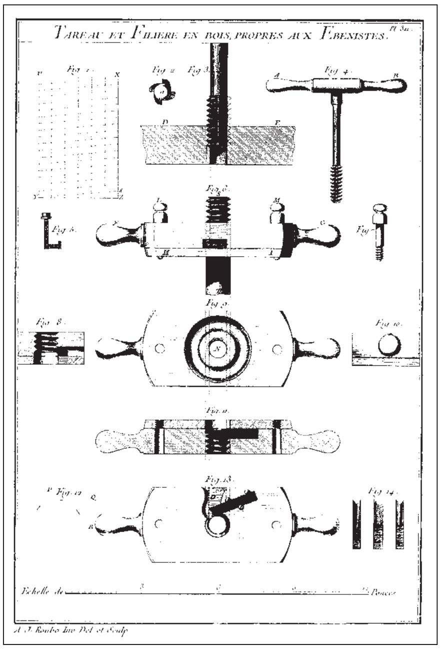
clout nail (n)
A wrought iron nail with a large, flat head, usually used in furniture construction for fastening backboards onto a carcase.

clenched nail (n)
A wrought nail that is driven through the workpiece, then bent back into the undersurface thereof through use of a hammer and bucking iron (or any metal plate, including a second hammer).

cut brad (n)
A thin nail on which the head extends to only one side. A cut brad has a slight bend at the point end, which makes it easy to bend. Cut brads are typically rectangular in cross-section. The thickness of the brad is consistent along its length. It is tapered in width.

cooper (v)
Traditionally, to cooper is to make wooden staved vessels of conical form with flat ends that are bound together with hoops. Now the term is sometimes used to refer to any curved surface comprised of staves or slats, such as a coopered door or lid.

> *"Language is not an abstract construction of the learned, or of dictionary makers, but is something arising out of the work, needs, ties, joys, affections, tastes, of long generations of humanity, and has its bases broad and low, close to the ground."*
>
> — Noah Webster (1758-1843)
> American lexicographer



André Roubo's plate showing how a threadbox works.

gain (n)
A notch cut into the work that is designed to receive another piece of wood, such as the bar of a mullion, or hardware, such as the leaf of a hinge.

James Gibbs (n)
Scottish-born James Gibbs (1682-1754) was one of Great Britain's most influential architects due his books, which became popular pattern books for English architecture. His best-known buildings are St. Martin-in-the-Fields, in London, and the domed Radcliffe Camera at Oxford University, in Oxford.

"L'Art du Menuisier" (n)
André Jacob Roubo's five-volume opus from the late 18th century is one of the most important (and comprehensive) early publications on the craft of woodworking. It is, unfortunately for English speakers, written entirely in French.

micrometer (n)
A device with a calibrated screw used for precise measuring of small distances.

parquetry (n)
A geometric and angular mosaic of wood pieces, often used in veneer panels for furniture. When wood pieces in veneer are curved or have natural shapes, the proper term is "marquetry."

quirk (n)
A narrow groove that separates and defines one profile from the next in a run of moulding.

shear cut (n)
A cut in which the blade (or blades) are at an angle to the wood. A shear cut lowers the effective angle of the cut and the force necessary to execute it. In handplane use, a shear cut (achieved by skewing the plane) allows you to move the plane across the wood's surface with less effort. In planer and jointer cuts, a shear cut is achieved by the angle at which the knives are attached to the cutterhead.

studio furniture (n)
Typically describes contemporary furniture pieces that are built one at a time to exacting standards, such as those by Robert Whitley, Wendell Castle and the late James Krenov.

Waxilit (n)
A silicone-free paste wax that can be applied as a thin film around areas to be joined before glue-up. Glue squeeze-out is easily lifted from the treated area, then the Waxilit can be cleaned off with alcohol to prepare the surface for finish. The product is also used to coat and protect metal surfaces such as jointer beds and bar clamps.

wheelwright (n)
A person who builds and repairs wheels, historically for the cart, carriage and wagon trades. Today, the term remains in use to describe those who make and repair wheels for horse-drawn vehicles. **PWM**

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BY BRENDAN ISAAC JONES

Squirrel Surprise

A project with a bite.

How do three carpenters feed an abandoned baby squirrel? Glass dropper in hand, huddled around a kitchen table in the historic district of downtown Alexandria, Va., we discovered the answer: with great difficulty.

The day previous, atop scaffolding in the driving rain, Jay pried off a return from the termite-damaged cornice of a house on Prince Street. We heard the sound of scampering, and a rust-red squirrel exploded out from the darkness of rotted wood. It balanced briefly on Jay's arm, seemed to consider the weather, then trotted down the side of the building. So it goes when you're replacing the entire cornice on a 19th-century townhouse. Back to work.

The following day, as we replaced termite-ridden framing, a splinter of wood fell on the yellow grating of the scaffold. Just before we swept it onto the waiting canvas 40' below, the splinter moved, and revealed a dun-colored belly, tiny whiskers and two slits where eyes should be. It looked, with its little arms, like a ginger root. We picked him up, and decided we had in our hands a baby squirrel. Naturally, we named him "Cornice."

So there we were, around the table at our temporary apartment, dropper filled with warm milk. The liquid dribbled down Cornice's cheeks, gathered in the creases of Niko's hands, and ended up on, rather than in, the squirrel's belly. Worried, we bundled him up in Niko's fleece pants and set him by the radiator.

The next evening the three of us stopped off at the drug store and bought baby formula, much to the amusement of the cashier. Back home we heated it on the stove and took up our positions around the kitchen table. I dialed the number for animal rescue and had my finger over the Send button. Then Jay let out a yelp. "He's sucking!" Indeed he was, and eagerly, as if his life depended on it – which it surely did.

Thus began the era of our shop squirrel. His eyelids, as if operated by a slow-moving pump jack, opened gradually, revealing two brown beads. His fur grew in and his tremendous tail grew out. Through research, we found out we had on our hands a relatively rare Del Ray squirrel.

I'm sure he got us jobs – and perhaps lost us a few – when people saw him scampering over the table saw and perched like a bowsprit on the band saw. He'd flit over your shoulder as you made a cut on the chop saw; rotate strawberries between his paws like corn on the cob; spiral up and down your leg as you attempted to move lumber, and generally be a hilarious pain in the butt. Cornice's nails, undulled by tree bark, became something of a liability.

Caring for him began to weigh on Niko, his primary keeper. Left at home, Cornice almost killed himself by running rampant and eating oil-based orange paint. The Ford Taurus where Cornice spent much of his time began to resemble a squirrel nest, with nutshells strewn about, almonds in the seat crevices, and deposits of peanut-butter colored squirrel doo heating in the sun on the dash.

We contemplated building a squirrel habitat in Niko's garden. Indeed Cornice would play outside, and come home to sleep – often in Niko's bed, closing his eyes only after a thorough stomach scratching. It seemed a plausible dream.

Then he bit a neighbor of Niko's, drawing blood. Then another. Then he chewed through his plastic carrier. Cornice's days of domesticity were drawing to a close.

We released our friend into the Schuykhill Valley Nature preserve. Niko later reported seeing him with another squirrel, seemingly at peace in the wild. Perhaps, years down the line, a biologist will report a new population of Del Ray squirrels in the Philadelphia area – and we'll know our guy has been busy. **PWM**

Brendan is the owner and founder of Greensaw Design & Build in Philadelphia.

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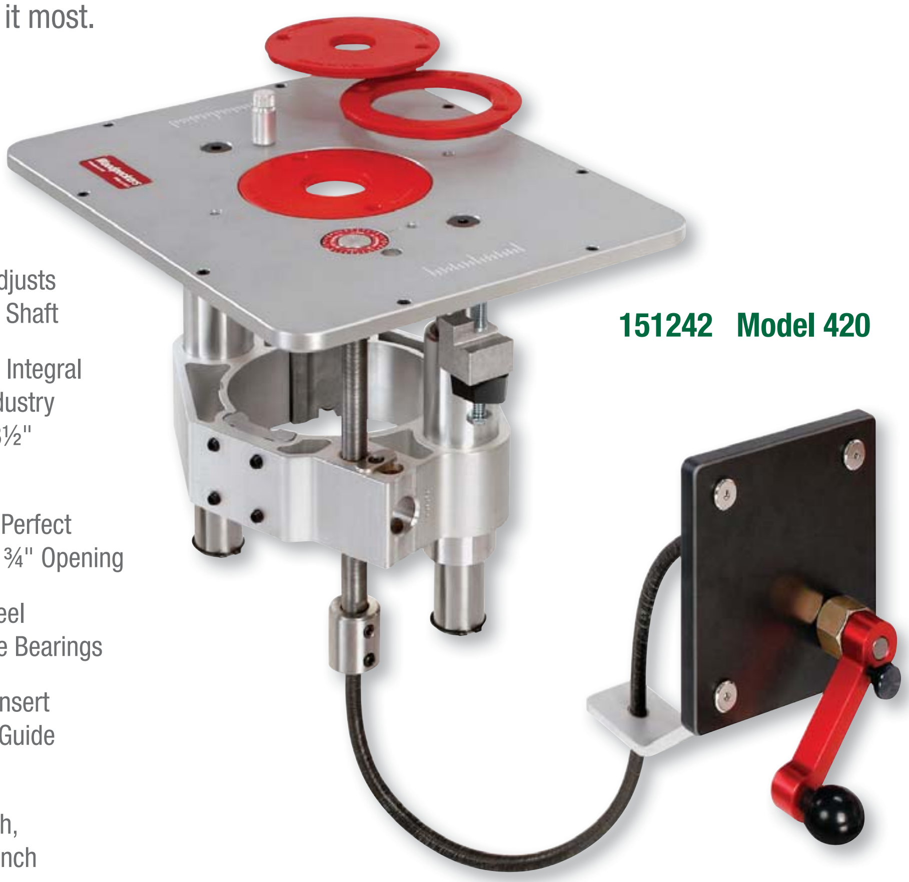

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